IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

SING et al. TC/A.U. 3747

Serial No. 10/664,360 Examiner: A. Castro

Filed: September 15, 2003 Date: July 26, 2004

Title: SPRING RELEASE STARTER FOR CHAIN SAW

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE/AMENDMENT/LETTER

This is a response/amendment/letter in the above-identified application and includes an attachment which is hereby incorporated by reference and the signature below serves as the signature to the attachment in the absence of any other signature thereon.

☐ **Correspondence Address Indication Form Attached.**

Fees are attached as calculated below:

Total effective claims after amendment 0 minus highest number previously paid for 20 (at least 20) = 0 x $	$	0.00
Independent claims after amendment 0 minus highest number previously paid for 3 (at least 3) = 0 x $	$	0.00
If proper, multiple dependent claims now added for first time, add $ (ignore improper)	$	0.00
Petition is hereby made to extend the current due date so as to cover the filing date of this paper and attachment(s) ($ /1 month; $ /2 months; $ /3 months)	$	0.00
Terminal disclaimer enclosed, add $	$	0.00
☐ First/second submission after Final Rejection pursuant to 37 CFR 1.129(a) ($) ☐ Please enter the previously unentered , filed ☐ Submission attached	$	0.00
Subtotal	$	**0.00**
If "small entity," then enter half (1/2) of subtotal and subtract ☐ Applicant claims "small entity" status. ☐ Statement filed herewith	-$	0.00
Rule 56 Information Disclosure Statement Filing Fee ($)	$	0.00
Assignment Recording Fee ($)	$	0.00
Other: Fee of $180.00 set forth in § 1.17(p)		**180.00**
TOTAL FEE ENCLOSED	$	**180.00**

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140. A duplicate copy of this sheet is attached.

1100 North Glebe Road, 8th Floor
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NIXON & VANDERHYE P.C.
By Atty: Alan M. Kagen, Reg. No. 36,178

Signature: Alan M. Kagen

Approved
6/14/06

866305

JUL 2 6 2004

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Independent claims after amendment **0** minus highest number previously paid for **3** (at least 3) = 0 x $	$	0.00
If proper multiple dependent claims now added for first time, add $ (ignore improper)	$	0.00
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In re Patent Application of

SING et al.

Appl. No. 10/664,360 TC/A.U. 3747

Filed: September 15, 2003 Examiner: A. Castro

For: SPRING RELEASE STARTER FOR CHAIN SAW

* * * * * * * * * * *

July 26, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CITATION OF PRIOR ART UNDER 37 C.F.R. §1.99

Prior art is submitted herewith that may be relevant to the subject patent application. According to 37 C.F.R §1.99, included herewith are:

(1) the fee of $180.00 set forth in § 1.17(p);

(2) a list of the patents or publications submitted for consideration by the Office, including the date of publication of each patent or publication;

(3) a copy of each listed patent or publication in written form; and

(4) an English language translation of all the necessary and pertinent parts of any non-English language patent or publication in written form relied upon.

07/27/2004 SSANDARA 00000011 10664360
01 FC:1806 180.00 OP

A copy of this submission has been mailed via certified mail to the correspondence address listed on the front face of the published application (a copy of the certified mailing receipt is also attached).

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: Alan M. Kagen

Alan M. Kagen
Reg. No. 36,178

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Attachments:

U.S. Patent No. 5,287,832 - February 22, 1994
U.S. Patent No. 6,508,220 - January 21, 2003
U.S. Patent No. 6,588,390 - July 8, 2003
U.S. Published Patent Application No. US 2004/0016311 - January 29, 2004
Japan Utility Model Publication No. 6-16964 and English Translation - May 2, 1994

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US005287832A

United States Patent [19]

Uhl

[11] Patent Number: 5,287,832

[45] Date of Patent: Feb. 22, 1994

[54] STARTING DEVICE FOR AN INTERNAL COMBUSTION ENGINE

[75] Inventor: Klaus-Martin Uhl, Esslingen, Fed. Rep. of Germany

[73] Assignee: Andreas Stihl, Waiblingen, Fed. Rep. of Germany

[21] Appl. No.: 966,435

[22] Filed: Oct. 26, 1992

[30] Foreign Application Priority Data

Oct. 26, 1991 [DE] Fed. Rep. of Germany 4135405

[51] Int. Cl.[5] F02N 3/02

[52] U.S. Cl. ..... 123/185.3; 74/7 C

[58] Field of Search ..... 123/185.2, 185.3, 185.4, 123/179.29; 74/7 C; 192/42, 41 S

[56] References Cited

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4,019,490	4/1977	Reese	123/185.3
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4,641,614	2/1987	Krebs	123/185.2
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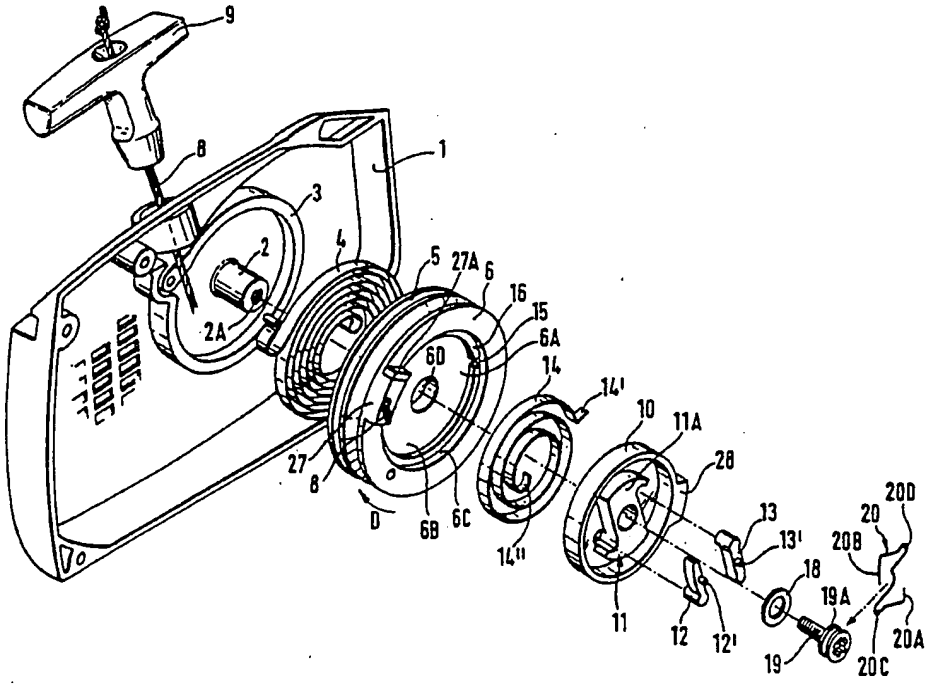
4,848,288	7/1989	Murase et al.	123/179.24
5,063,812	11/1991	Mercier	123/185.2

Primary Examiner—Tony M. Argenbright
Assistant Examiner—M. Macy
Attorney, Agent, or Firm—Walter Ottesen

[57] ABSTRACT

The invention is directed to a starting device for manually starting an internal combustion engine and especially a two-stroke engine. The starting device comprises essentially a clutch drum which is actuated by a pull rope for imparting rotation to a catch which coacts with a clutch element of the engine shaft. The starting device maintains within limits the effects of stronger fluctuations of the reaction torque of the engine shaft on the hand of the operator. This is achieved in that the clutch drum and the carrier of the catch are configured as separate parts and are connected by an elastically-deformable entraining element which takes up the force peaks of the reaction torque.

36 Claims, 6 Drawing Sheets



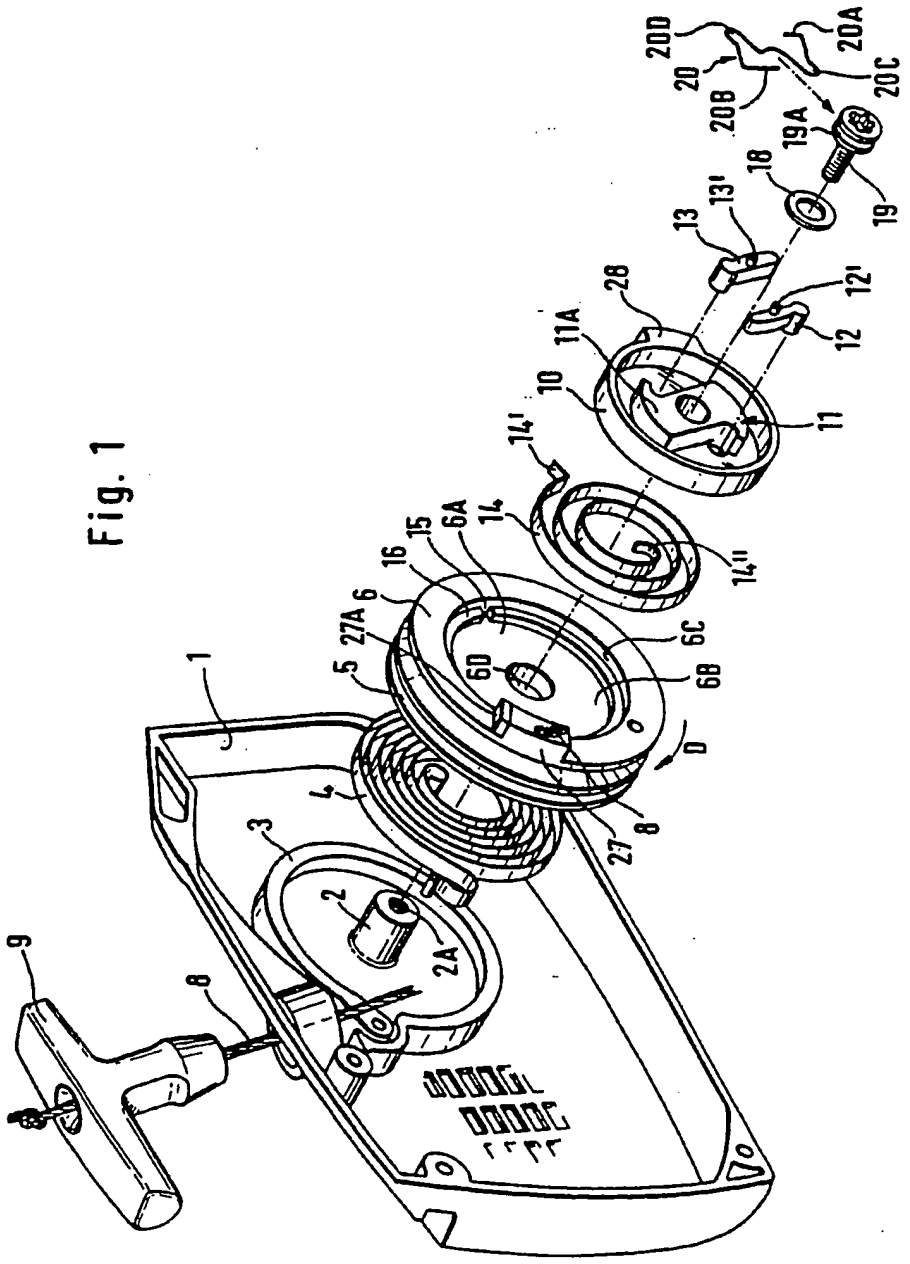


Fig. 1

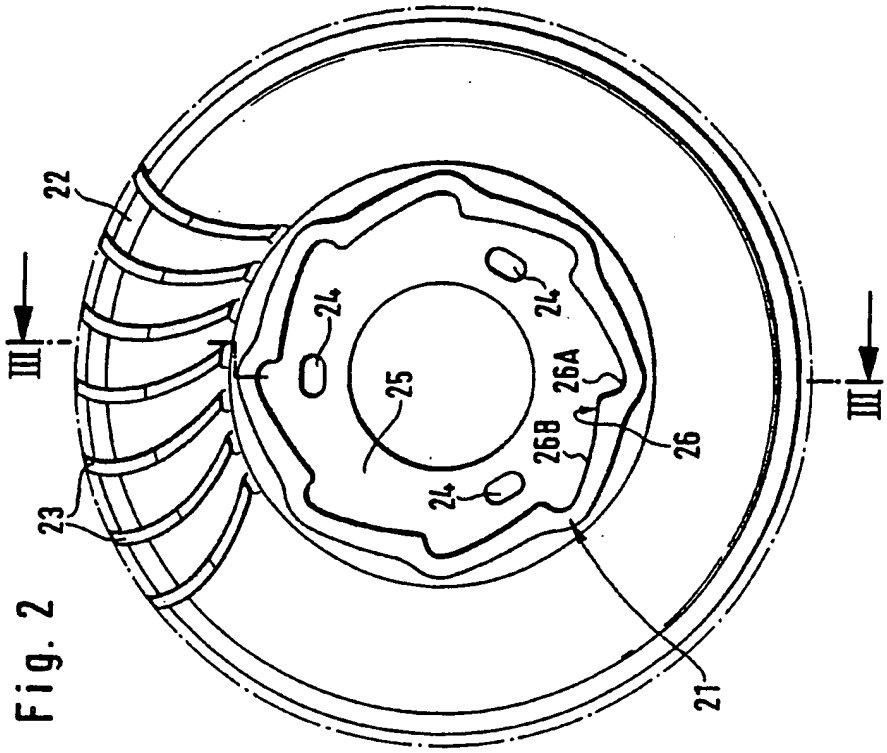


Fig. 2

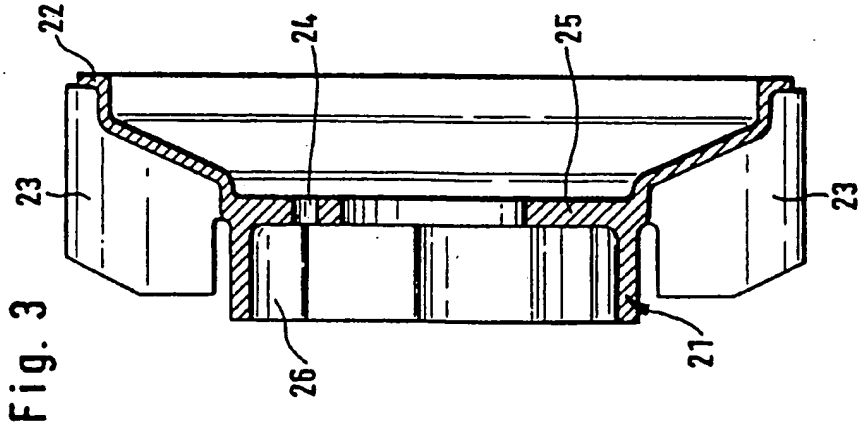


Fig. 3

Fig. 4

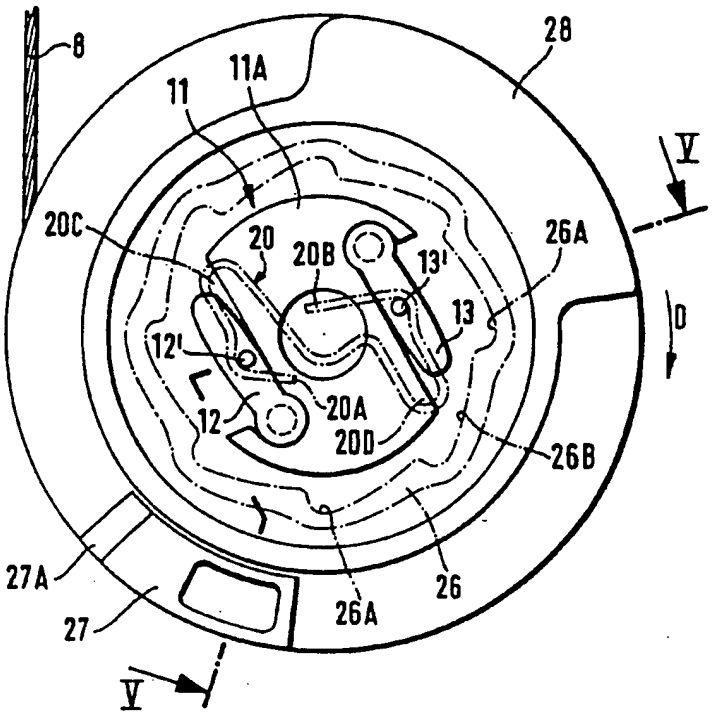


Fig. 5

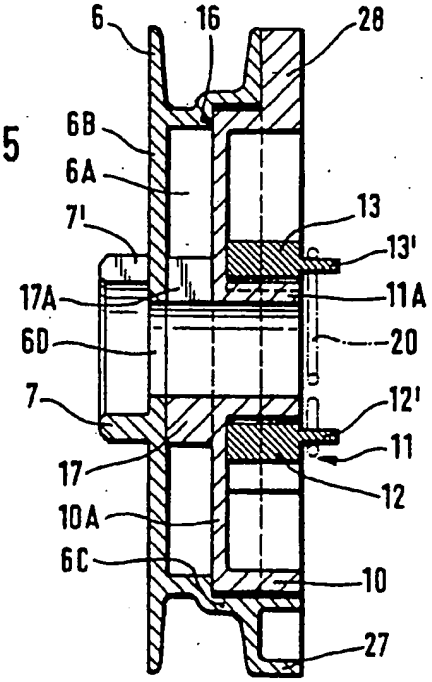


Fig. 6

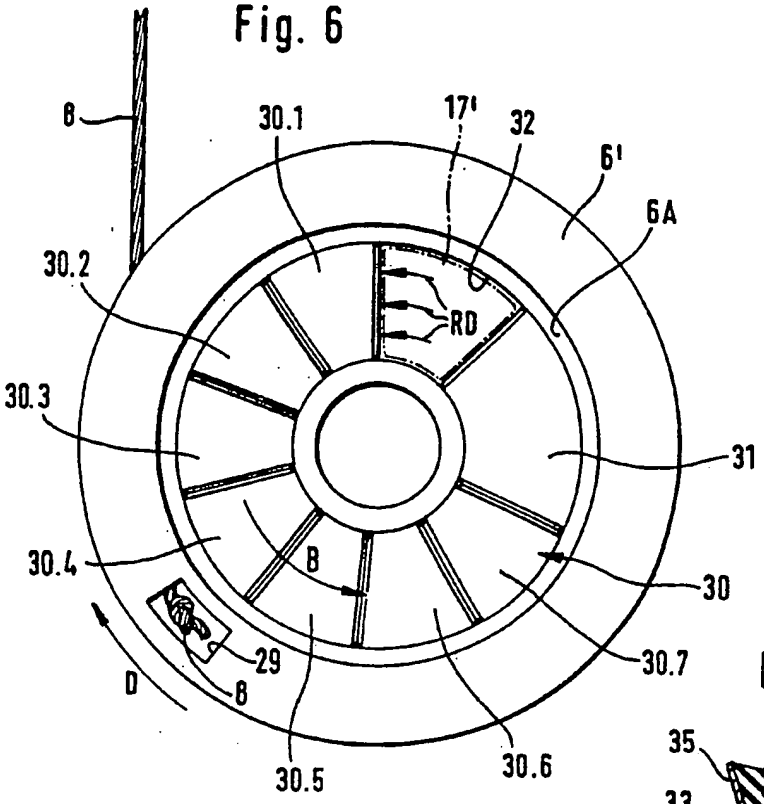


Fig. 8

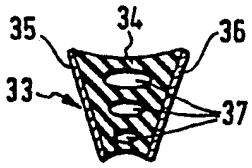


Fig. 7

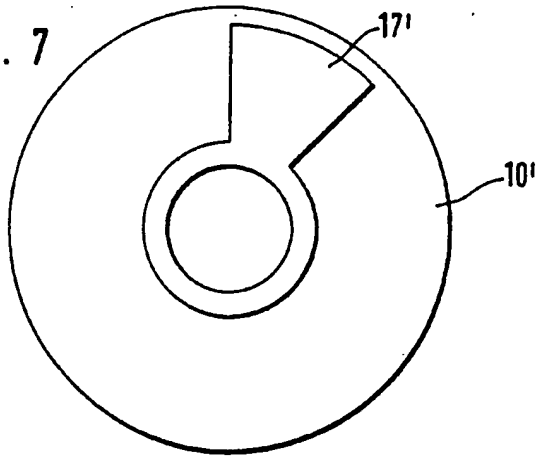


Fig. 9

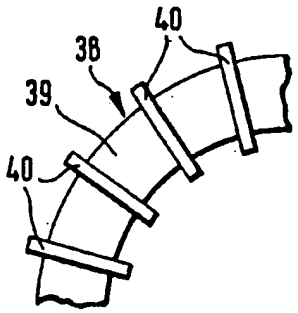


Fig. 10

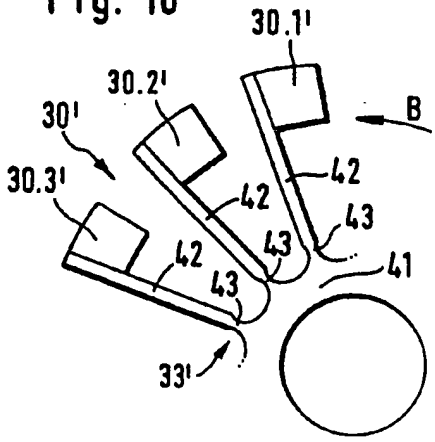


Fig. 11

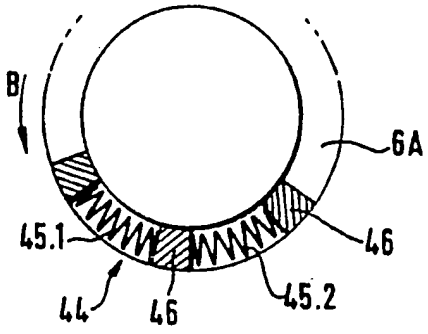


Fig. 12

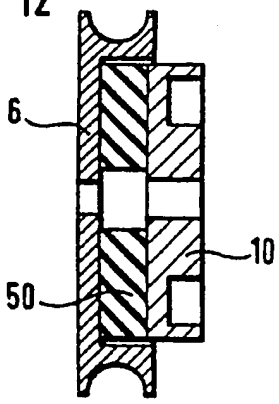


Fig. 13

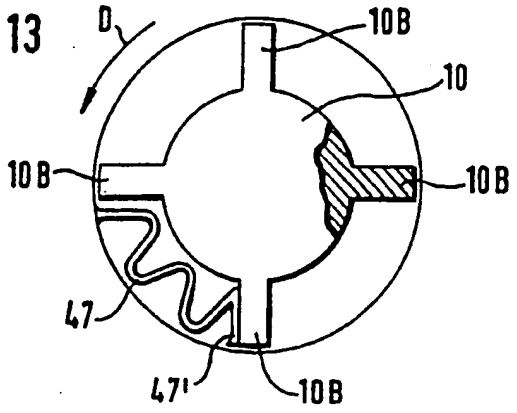


Fig. 14

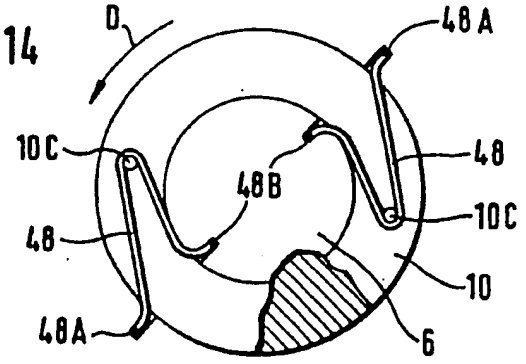
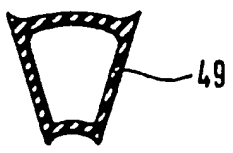


Fig. 15



UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,287,832

DATED : February 22, 1994

INVENTOR(S) : Klaus-Martin Uhl

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, under U.S. PATENT DOCUMENTS: delete "Prers" and substitute -- Frers -- therefor.

In column 7, line 5: delete "30.1," and substitute -- 30.1', -- therefor.

In column 8, line 26: delete "arm" and substitute -- drum -- therefor.

In column 8, line 51: between "extending" and "said", insert -- into --.

In column 8, line 52: between "section" and "the", insert -- during --.

In column 12, line 39: delete "i" and substitute -- in -- therefor.

In column 14, line 29: delete "electrically" and substitute -- elastically -- therefor.

Signed and Sealed this

Twenty-first Day of June, 1994

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

STARTING DEVICE FOR AN INTERNAL COMBUSTION ENGINE

FIELD OF THE INVENTION

The invention relates to a starting device for an internal combustion engine such as a pull-rope starting device for a two-stroke engine.

BACKGROUND OF THE INVENTION

A starting device of the above kind is disclosed in U.S. Pat. No. 4,127,098. The operation of such a starting device often presents difficulties because periodically high reaction forces occur as a result of the compression in the engine during starting. This causes changing forces which are temporarily very high to act on the hand of the operator. The force peaks acting on the handle of the starting device are that much greater the lighter the rotating masses of the engine are.

It is known for pull-rope starting devices for internal combustion engines that the periodically occurring high reaction forces can be prevented when the rope is wound on an oval or cornered disc of the clutch drum so that different pulling forces result when pulling the handle while unwinding the rope. These pulling forces are adapted to the fluctuating reaction torque. In this connection, reference can be made to U.S. Pat. Nos. 2,942,599 and 3,814,073. The arrangement requires a precise dimensioning, assembly and correlation of the winding of the rope disc in dependence upon the engine to be started. The constructive and manufacturing complexity for a starting device of this kind is therefore very great.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a starting device wherein the transfer of the especially intense reaction forces, which are caused by the compression of the internal combustion engine, on the handle of the starting device is reduced and wherein, as a consequence, the starting operation is facilitated.

The starting device of the invention is for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes the starting torque to fluctuate. The starting device includes: a housing; a clutch drum rotatably journalled in the housing and defining an axis of rotation; means for manually imparting a rotational movement to the clutch drum; a clutch member fixedly mounted to the engine shaft for rotation therewith; a carrier rotatably mounted in the housing so as to be rotatable about the axis; entraining means for connecting the clutch drum to the carrier for transmitting the rotational movement of the clutch drum to the carrier; catch means mounted on the carrier and being displaceable in response to the rotational movement from a rest position into an engaging position wherein the catch means engages and transmits the rotational movement to the clutch member; and, the entraining means being elastically deformable to compensate for the fluctuations of the starting torque.

The starting device according to the invention departs from the starting device disclosed in U.S. Pat. No. 4,127,098 in that the clutch drum of the starting device of the invention is not also the carrier of the catch which is brought into engagement with the clutch member of the engine shaft. Instead, this carrier is configured as a separate part and connected to the clutch

drum via an elastic deformable entraining device whereby fluctuations of the torque to be applied to the engine shaft are compensated. If the reaction torque increases beyond a specific value because of the compression in the engine, then the rotational movement of the carrier of the catch is delayed with reference to the rotational movement of the clutch drum since the entraining element elastically deforms opposite to the rotational movement. The catch is connected to the clutch member of the engine shaft so as to rotate therewith. The clutch drum therefore continues to be rotated with the same speed without the need for an increased force. The deformation forces are stored in the entrainment element as energy which is released during reduced reaction torque and therefore supports the continued rotational movement of the clutch drum and of the catch carrier. The resilient entrainment of the catch carrier operates in the desired manner to even out the force which must be exerted on the handle for the starting operation. Furthermore, construction and manufacturing complexity is minimal because only the clutch drum and the carrier of the catch must be produced as separate parts while interposing the elastically deformable entraining element while all other parts of the starting device remain unchanged.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the drawings wherein:

FIG. 1 is an exploded view of the starting device according to the invention;

FIG. 2 is a plan view of a clutch shell which is attached to the drive shaft of the engine;

FIG. 3 is a section view taken along line III-III of FIG. 2;

FIG. 4 is a plan view of the clutch drum of the starting device of FIG. 1 with the catch seated in place;

FIG. 5 is a section view taken along line V—V of FIG. 4;

FIG. 6 is a plan view of another embodiment of the clutch drum;

FIG. 7 is a rear view of a carrier for the catch with the carrier fitting into the clutch drum of FIG. 6;

FIG. 8 shows an embodiment of a rubber-elastic body for an entraining element for use with the clutch drum of FIG. 6;

FIG. 9 is a detail view of a portion of an alternate embodiment of an elastic entraining element;

FIG. 10 is another partial detail view of another embodiment of an elastic entraining element;

FIG. 11 is a detail partial view of another embodiment of an elastic entraining device;

FIG. 12 is a further embodiment of the connection between the clutch drum and the catch carrier via a rubber-elastic entraining element;

FIG. 13 is an embodiment of an entraining element configured as a folded strip spring;

FIG. 14 is a schematic of an entraining element configured as rubber-elastic pull bands; and,

FIG. 15 is a schematic showing an entraining element configured as a rubber-elastic hollow body.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

The starting device of FIG. 1 is provided for manually starting a two-stroke engine which is mounted for example in a motor-driven chain saw. The starting de-

vice is mounted in a housing 1 which is configured as a removable cover of the motor housing with the cover being provided with ventilating slots. A bearing lug 2 is mounted in the inner wall of the housing 1 and is surrounded by a spring housing 3 formed on the housing. A spiral spring 4 is disposed in the housing 3 and is firmly held at one end on the edge of this housing. The spiral spring is covered by a metal disc 5 and acts as a return spring for a clutch drum 6 configured as a rope drum. The clutch drum 6 has a rearward lug 7 (FIG. 5) which projects through a center bore of the metal disc 5 into the spring housing 3. The lug 7 shown in FIG. 5 has an axial slit 7' for the engagement of the inner end of the spiral spring 4. A rope 8 is wound on the clutch drum 6 and has a free end brought out of the housing 1 with this free end being attached to a handle 9. By pulling on the rope by means of the handle, the clutch drum 6 is set into rotational motion about the bearing lug 2 while the rope unwinds.

The clutch drum 6 has a circularly-shaped receiving space 6A surrounding the bearing lug 2. The receiving space 6A is for a cup-shaped carrier 10 of a catch 11 which has two pivotally-journalled pawls 12 and 13. An elastically deformable entraining element 14 is disposed between the carrier 10 and the end wall 6B of the clutch drum 6 delimiting the receiving space 6A. The entraining element 14 in the embodiment of FIG. 1 is configured as a spiral spring. The outer end 14' of the spiral spring is hooked into a slit 15 which is provided in a ring-shaped shoulder 16 of the inner wall 6C of the clutch drum 6. This shoulder 16 surrounds the spiral spring 14 and the outer turn of this spring lies against the inner wall of the shoulder 16. The catch carrier 10 is rotatably journalled on the bearing lug 2 (FIG. 1).

The clutch drum 6 is journalled on the catch carrier 10. The shoulder 16 of the clutch drum 6 has an end face defining a sliding surface (FIG. 5). The catch carrier 10 has an entraining projection 17 (FIG. 5) which is centrally disposed and is spirally configured at the periphery. The projection 17 extends from the base 10A of the carrier 10 toward the end wall 6B of the clutch drum 6 and delimits the ring-shaped receiving space 6A in this region on the inner side. The inner end section of the spiral spring 14 lies on the entraining projection 17. The inner end of the spiral spring 14 is hooked into an axial slit 17A of the entraining projection 17 (FIGS. 1 and 5). A bearing mount 11A of the catch 11 is disposed on the base 10A of the carrier 10 and is configured as a single piece therewith. Two pawls 12 and 13 have respective thickenings whereat they are pivotally seated in this bearing mount 11A as shown in FIGS. 1, 4 and 5. The pawls 12 and 13 have respective lugs 12' and 13' which are directed outwardly.

In the mounted condition of the starting device, the bearing lug 2 fixed to the housing extends through a center bore 6D of the end wall 6B of the clutch drum 6 and the carrier 10. The entraining projection 17 of the carrier 10 and bearing mount 11A conjointly define a bushing-shaped receptacle for the bearing lug 2. A threaded bolt 19 is threadably engaged in an axial thread 2A of the bearing lug 2. An annular slot 19A is provided in the head of the threaded bolt 19 as shown in FIG. 1. A guide bracket 20 made of spring steel wire is seated in the annular slot 19A. The bracket 20 has two free legs 20A and 20B which engage around respective ones of pawl lugs 12' and 13' in the rest position of the clutch drum (FIG. 4). The end of the free leg 20B as well as the mid segment of the guide bracket 20 lie in the annular slot 19A. The guide bracket 20 has hairpin-shaped ends 20C and 20D wherein corresponding ones of pawl lugs 12' and 13' are disposed. A washer 18 is disposed between the guide bracket 20 and the bearing mount 11A of the catch 11 and is in surrounding relationship with respect to the head of the threaded bolt 19. The washer 18 ensures an undisturbed relative rotation between the guide bracket 20 and the bearing mount 11A.

The rotational movement of the clutch drum 6 is transmitted to a clutch element which is fixedly connected to the motor shaft to be driven so as to rotate therewith. In the embodiment shown in FIGS. 2 and 3, the clutch element is a clutch shell 21 configured as a single piece with the fan wheel 22 having vanes 23 arranged in a wreath-like manner around the wheel as shown. The clutch shell 21 has through openings 24 in the base 25 thereof for accommodating screws (not shown) with which the clutch shell is attached to a flange of the crankshaft of the two-stroke engine (not shown). It is however also possible to configure the clutch shell as one piece having a hub cast thereon for connecting to the crankshaft so as to rotate therewith, for example, by a Woodruff key. The inner wall of the clutch shell 21 is provided with teeth 26 with which the clutch shell 21 engages in the cup-shaped catch carrier 10 after the assembly of the starting device as shown in phantom outline in FIG. 4.

When the rotation is imparted to the clutch drum 6 by pulling on the rope 8, the clutch drum entrains the carrier 10 of the catch via the spring 14. The bearing mount 11A of the catch 11 then rotates about the bearing lug 2 while the guide bracket 20 at first retains its position since the bracket is frictionally held to the threaded bolt 19 and therefore to the bearing lug 2. The lugs 12' and 13' of the two pawls 12 and 13, respectively, are caused thereby to wander outwardly in the hairpin bends 20C and 20D, respectively, in a direction toward the end of the bends whereby the pawls 12 and 13 pivot outwardly. In this outwardly pivoted position, the pawls entrain the guide bracket 20 which then rotates against the friction resistance in the annular slot 19A of the threaded bolt 19 about the axis of the bearing lug 2. With a further rotation of the clutch drum 6 and therefore of the catch 11 (shown in FIG. 4 in clockwise direction D), the pawls 12 and 13 remain in their outwardly-pivoted positions and then engage in respective tooth gullets 26A of the teeth 26. In this way, rotation is imparted to the clutch shell 21 (FIGS. 2 and 3) and therefore also to the engine shaft to be driven. When the engine has started running and the pregiven rotational speed is reached, the clutch shell 21 with its teeth 26 overtakes the catch 11 with the pawls 12 and 13 being pivoted back along the teeth at the flanks 26B. Also for every start operation after releasing the handle 9, the pawls are returned to their initial positions during the return rotation of the clutch drum 6 under the control of the guide bracket 20.

The compression of the engine increases up to top dead center of the piston when rotating the engine shaft and falls off again. The reaction torque periodically fluctuates correspondingly, which is effective as high force peaks for the conventional starting devices, which must be developed when starting. To compensate for this periodic change for this force to be developed, the elastically deformable entraining element is provided which is configured as a spiral spring 14 in the embodiment of FIG. 1. The spring 14 is so dimensioned that it

entrains the carrier 10 of the catch 11 with the rotational speed of the clutch drum 6 as long as the reaction torque of the engine shaft remains below a pregiven limit value. The piston of the engine therefore is in the region forward and rearward of its dead-center position. With an increase in the reaction torque above this limit value, the spiral spring 14 deforms by closing its turns so that the rotational speed of the catch carrier reduces while the clutch drum 6 can be rotated further at the same rotational speed and approximately with the same force being exerted. The clutch drum 6 then rotates in the rotational direction D (FIGS. 1 and 4) additionally relative to the catch carrier 10 which is seated with slight play in the clutch drum. The height of the spiral spring 14 made of a flat strip steel is so dimensioned that the base 10A of the carrier 10 is not continuously in contact with the spring. The intermittent contact of the spiral spring 14 on the carrier base 10A is possible which provides a guard against axial displacement of the spring turns. A stop 27 is formed at the outer flange of the clutch drum in order to limit the relative movement between the clutch drum 6 and the catch carrier 10. A counter stop 28 is provided on the carrier 10 for the stop 27 as shown in FIGS. 1 and 4. The stop 27 includes a buffer 27A of rubber-elastic material at its forward end viewed in the direction D.

When the reaction torque again drops below the pregiven limit value after passing top dead center of the engine piston, the spiral spring 14 relaxes to its start position with the catch carrier 10 entrained by the spring moving relative to the clutch drum 6 in the direction D. The spiral spring 14 therefore acts simultaneously as an energy store which supplies energy to the carrier 10 which was stored during the previous deformation and in this way accelerates the carrier 10 so that the carrier 10 reaches for a short time an absolute rotational speed greater than the clutch drum and can then again rotate at the speed of the clutch drum.

The return spring 4 is provided for returning the clutch drum 6 into its start position so that the rope 8 can be rewound after being pulled from the clutch drum as is conventional with a pull-rope starting device. Only a slight friction develops between the spring housing 3 and the clutch drum during the rotational movement of the latter because the spring housing 3 is covered by the metal disc 5.

FIGS. 6 to 8 show another embodiment of the elastically-deformable entraining element with the clutch drum and the catch carrier being correspondingly adapted.

In the plan view of FIG. 6, the outer flange and the ring-shaped receiving space 6A of the clutch drum 6' can be seen. The flange has no projection corresponding to the stop 27 of FIG. 1 so that the end of the rope 8 is not guided through such a stop as in FIG. 1; instead, the rope is provided with a knot at a corresponding pass-through opening 29 of the flange.

A part ring-shaped entraining element 30 made of an elastomer is disposed in the ring-shaped receiving space 6A. The entraining element 30 in this embodiment comprises seven rubber-elastic bodies 30.1 to 30.7 which have a shape corresponding to a truncated sector of a circle as shown in FIG. 6. The rubber-elastic bodies are arranged so that they lie one next to the other with their side surfaces. The bodies 30.1 to 30.7 have rounded edges and adequate play within the receiving space 6A so that they can each individually deform elastically. The rubber-elastic body 30.7 adjoins a rigid filler body 31 which is rigidly connected to the clutch drum 6' and can be configured as a single piece therewith. A chamber 32 which opens outwardly is left free between the filler body 31 and the elastic body 30.1. The chamber 32 likewise has a shape corresponding to a truncated sector of a circle as shown in FIG. 6. In this embodiment, a catch carrier 10' is provided having an entraining projection 17' on its rearward wall (FIG. 7) which likewise has a shape corresponding to a truncated sector of a circle and fits into the chamber 32. The entraining projection 17' is shown in phantom outline in FIG. 6.

If the clutch drum 6' is rotated in the direction D for the starting operation, then the corresponding torque is transmitted from the fill body 31 to the entraining projection 17' of the catch carrier 10' via the rubber-elastic entraining element 30. The reaction torque of the engine shaft then acts in the direction of arrows RD on the first rubber-elastic body 30.1 and, via this body, on the rubber-elastic bodies which follow so that the entraining element 30 is loaded against the filler body 31 in the direction B. If the reaction torque RD exceeds the pregiven limit value, then the rubber-elastic body 30.1 is first deformed and, with a further increase of the reaction torque, the additional rubber-elastic bodies 30.2 to 30.7, which follow sequentially, deform. The entraining element 30 then stores energy which this element supplies to the entraining projection 17' during the subsequent load relaxation and thereby can supply this energy to the catch carrier 10'.

The rubber-elastic bodies 30.1 to 30.7 all have the same shape but can be configured differently and, with a suitable selection of material, they can define different characteristics of this elastomeric spring.

FIG. 8 shows an embodiment of the rubber-elastic bodies 30.1 to 30.7. A rubber element 34 is held in a holder 33 which comprises two mutually adjacent plates 35 and 36. The rubber element 34 is preferably attached by vulcanization to the plates 35 and 36. Recesses 37 are provided in the rubber element 34 for obtaining a pregiven form elasticity. The plates 35 and 36 are advantageously made of plastic and contribute to the uniform transfer of the reaction torque RD.

Additional embodiments for the elastically-deformable entraining element are shown in FIGS. 9 to 12.

A ring-shaped rubber elastic band 39 is provided as an entraining element 38 in FIG. 9. Individual carrier rings 40 in spaced relationship to each other are attached to band 39. In this embodiment, an end carrier ring is attached to the entraining projection of the catch carrier and the other end carrier ring is connected to the clutch drum in such a manner that the elastic band 39 is stressed in tension with the carrier rings 40 acting as slide bearings. In this case, an outer stop corresponding to the embodiment of FIG. 1 must be provided in order to avoid overexpanding the band. It is, however, also possible to select the material and the thickness of the rubber-elastic band 39 so that the entraining element 38 is stressed with pressure. The band 39 between the carrier rings 40 is then compressed. As soon as the band completely fills out the space left free for its deformation, a further relative movement between the clutch drum and the catch carrier is no longer possible in the loading direction B (FIG. 6) because rubber is incompressible so that an additional stop is not needed as is the case in the embodiment of FIG. 6.

FIG. 10 shows a holder 33' for the rubber-elastic bodies of which only three bodies 30.1', 30.2' and 30.3' are shown. These rubber-elastic bodies are configured

to have a block-like shape and with the holder 33' conjointly define an entraining element 30'. The holder comprises a ring-shaped carrier body 41 having rods 42 projecting radially outwardly on which respective rubber-elastic bodies 30.1, 30.2' and 30.3' are attached at a spacing from the next adjacent body.

It is advantageous to make the holder 33' of plastic and thereby form elastic. The rods 42 extend into the carrier body 41 with the respective joints 43 so that they can pivot toward each other under the elastic deformation of the plastic. When the entraining device 30' is loaded in the direction B, the rubber-elastic body 30.1' is first elastically deformed and thereafter the corresponding rod 42 pivots in the direction B until this rod strikes the rubber-elastic body 30.2' which is likewise deformed with increasing reaction torque so that the pivot movements which follow one another continue up to the last rod. The rod 42 having the rubber-elastic body 30.1' moves the longest distance.

FIG. 11 shows still another embodiment wherein an entraining element 44 is seated in the receiving space 6A of the clutch drum. The entraining element 44 is configured as a coiled pressure spring. The pressure spring comprises individual springs of which two individual springs 45.1 and 45.2 are schematically shown. A slide body 46 is arranged between each two mutually adjacent individual springs. When the entraining element 44 is loaded in the direction B, the individual spring 45.1 is first pressed together and displaces the slide body 46 which then applies pressure to the individual spring 45.2. The displacement movement is limited by the maximum path of the compression of the individual springs. These individual springs are pressed together to form a block so that their individual turns lie tightly one against the other. The individual springs can also be configured to be barrel-shaped and then comprise spring steel wire. The barrel shape makes it possible to push mutually adjacent turns one inside the other whereby the spring path is greater in comparison to coil springs.

In FIG. 12, an especially simple embodiment is shown for the torsion spring connection between the catch carrier 10 and the clutch drum 6. A rubber layer is vulcanized to the catch carrier 10 and to the clutch drum 6 and thereby defines a ring-shaped rubber-elastic entraining element 50. The two end faces are fixedly connected to the base of the catch carrier and to the inner end face of the clutch drum, respectively. An annular gap is left between the peripheral surface of entraining element 50 and the inner wall of the clutch drum. The rubber elastic entraining element 50 deforms with a relative movement between the clutch drum 6 and the catch carrier 10 and is thereby stressed in shear.

Further embodiments are shown in FIGS. 13, 14 and 15. In FIG. 13, in lieu of a coil spring (FIG. 11), a folded strip spring 47 made of plastic can be used. The strip spring 47 is attached with its end 47' to the end wall 6B of the clutch drum 6 (see FIG. 1) and is, for example, formed to have a point at this end and placed between two inner struts 10B of the catch carrier 10. In the embodiment, four struts 10B are formed on the catch carrier 10 so that four folded strip springs are provided on the clutch drum 6 with the direction of the clutch drum being indicated by arrow D in FIG. 13. In the embodiment of FIG. 14, two rubber-elastic pull bands 48 are used in lieu of the rubber-elastic band 39 (FIG. 9) which lie diametrically opposite each other. Each pull band 48 is attached on radially opposite positions of the clutch drum with its ends 48A and 48B and hooked to a lug 10C of the catch carrier 10. Furthermore, as shown in FIG. 15, rubber hollow bodies 49 can be used in lieu of the solid rubber bodies (FIG. 6 and FIG. 8). The rubber hollow bodies can be filled with gas so that the entraining element is configured as a gas spring.

Most parts of the starting device (FIG. 1) are made of plastic. Accordingly, the housing 1, the spring housing 3, the clutch drum 6, the catch carrier 10 and the catch 11 with pawls 12 and 13 are made of plastic. Manufacture and assembly of the starting device are therefore especially cost-effective.

It is understood that the foregoing description is that of the preferred embodiments of the invention and that various changes and modifications may be made thereto without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch arm rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and said catch means including a mount on said carrier and two pawls pivotally mounted on said mount so as to be displaceable in response to said rotational movement from a rest position into an engaging position wherein said two pawls engage and transmit said rotational movement to said clutch member; and,

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque.

2. The starting device of claim 1, said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and, said entraining means having an end section and said carrier having a projection extending said receiving space for supporting said end section the rotational movement of said clutch drum.

3. The starting device of claim 1, wherein said clutch drum and said carrier move relative to each other about said axis as said entraining means elastically deforms; and, stop means formed on said clutch drum and said carrier for limiting the relative movement therebetween.

4. The starting device of claim 1, said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and, said entraining means comprising a plurality of rubber-elastic bodies disposed one next to the other in said circularly-shaped receiving space so as to be elastically deformable within said receiving space.

5. The starting device of claim 4, said entraining means further comprising a rigid filler body fixedly

attached to said clutch drum and disposed next to said plurality of rubber-elastic bodies.

6. The starting device of claim 5, said entraining means further comprising an entraining projection disposed on said carrier and extending into said circularly-shaped receiving space next to said plurality of rubber-elastic bodies; and, said filler body being disposed ahead of said entraining projection when viewed in the direction of said starting torque; and, said filler body being connected with said plurality of rubber-elastic bodies for transmitting the starting torque thereto which is applied to said clutch drum.

7. The starting device of claim 6, said entraining projection and said filler body each having a shape corresponding to a sector of a circle when said clutch drum is viewed in plan.

8. The starting device of claim 7, each of said rubber-elastic bodies likewise having a shape corresponding to a sector of a circle and being disposed in said receiving space so as to be one adjoining the other so as to leave free regions in said receiving space for the elastic deformation of said rubber-elastic bodies.

9. The starting device of claim 1, said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and, said entraining means comprising rubber elastic hollow bodies interposed between said clutch drum and said carrier.

10. The starting device of claim 1, said means for manually imparting said rotational movement to said clutch drum comprising: a pull rope track formed on said clutch drum; spring means for resiliently biasing said clutch drum into a start position; and, a pull rope wound up on said pull rope track when said clutch drum is in said start position.

11. The starting device of claim 1, a bearing lug fixedly mounted on said housing; said clutch drum having an end wall adjacent said carrier and said end wall defining a center bore for receiving said bearing lug therein thereby rotatably journalling said clutch drum thereon; said carrier likewise being rotatably journalled on said bearing lug; and, said catch means further including: a guide bracket for resiliently biasing said pawls into said rest positions thereof; and, said guide bracket being mounted on said bearing lug so as to be frictionally held thereon.

12. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum and said carrier move relative to each other about said axis as said entraining means elastically deforms;

stop means formed on said clutch drum and said carrier for limiting the relative movement therebetween;

said clutch drum having an outer peripheral end face extending transversely to said axis and surrounding said carrier;

said carrier having an outer periphery; and,

said stop means including a first stop formed on said end face and a second stop formed on said outer periphery for contact engaging said first stop to limit said relative movement.

13. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

a bearing lug fixedly mounted on said housing;

said clutch drum having an end wall adjacent said carrier and said end wall defining a center bore for receiving said bearing lug therein thereby rotatably journalling said clutch drum thereon;

said carrier likewise being rotatably journalled on said bearing lug; said catch means including a mount on said carrier and two pawls pivotally mounted on said mount for moving between said rest and engaging positions;

a guide bracket for resiliently biasing said pawls into said rest positions thereof; and,

said guide bracket being mounted on said bearing lug so as to be frictionally held thereon.

14. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said entraining means having an end section and said carrier having a projection extending into said receiving space for supporting said end section during the rotational movement of said clutch drum;

said carrier being a dish-shaped carrier seated in said receiving space of said clutch drum with slight play;

said carrier having a base recessed in said clutch drum and a side wall;

said carrier means including a bearing mount fixedly disposed on said base and two pawls pivotally mounted on said bearing mount for moving between said rest and engaging positions;

said bearing mount and said side wall conjointly defining an annular space wherein said pawls move between said positions; and,

said clutch member having engaging means disposed in said annular space for coacting with said pawls when said pawls are in said engaging position.

15. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said entraining means having an end section and said carrier having a projection extending into said receiving space for supporting said end section during the rotational movement of said clutch drum;

said clutch drum having a base wall and a side wall extending from said base wall to define said circularly-shaped receiving space; and,

said side wall having a ring-shaped shoulder formed thereon defining a seating surface for receiving said carrier thereon.

16. The starting device of claim 15, said entraining means being a spiral spring having first and second ends connected to said clutch drum and said carrier, respectively.

17. The starting device of claim 16, said end section having said second end formed thereon and said second end being an inner bent-over end piece; said projection being concentric with said axis and having a spirally shaped surface for receiving said end section thereon; said projection having an axial slot formed therein for receiving said bent-over end piece therein; said first end of said spiral spring being an outer end having a bent-over end piece; and, said side wall defining a slit for receiving said bent-over end piece of said outer end therein.

18. The starting device of claim 17, said spiral spring being pretensioned in the direction of said starting torque.

19. The starting device of claim 18, said spiral spring having an outer turn lying in contact engagement with said ring-shaped shoulder when said spiral spring is in the relaxed state thereof.

20. The starting device of claim 15, said entraining means being made at least partially of elastomer.

21. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled i said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said entraining means comprising a plurality of rubber-elastic bodies disposed one next to the other in said circularly-shaped receiving space so as to be elastically deformable within said receiving space;

said entraining means further including a rigid filler body fixedly attached to said clutch drum and disposed next to said plurality of rubber-elastic bodies;

said entraining means further including an entraining projection disposed on said carrier and extending into said circularly-shaped receiving space next to said plurality of rubber-elastic bodies;

said filler body being disposed ahead of said entraining projection when viewed in the direction of said starting torque;

said filler body being connected with said plurality of rubber-elastic bodies for transmitting the starting torque thereto which is applied to said clutch drum;

said entraining projection and said filler body each having a shape corresponding to a sector of a circle when said clutch drum is viewed in plan;

each of said rubber-elastic bodies likewise having a shape corresponding to a sector of a circle and being disposed in said receiving space so as to be one adjoining the other so as to leave free regions in said receiving space for the elastic deformation of said rubber-elastic bodies; and,

each of said rubber-elastic bodies comprising a holder and rubber element held by said holder.

22. The starting device of claim 21, said holder of each of said rubber-elastic bodies including two plates disposed radially to said clutch drum; and, said plates being attached to said rubber element at respective lateral sides thereof.

23. The starting device of claim 22, each of said rubber elements having cutouts formed therein for obtaining a pregiven form elasticity.

24. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said entraining means including a plurality of rubber-elastic bodies disposed one next to the other in said circularly-shaped receiving space so as to be elastically deformable within said receiving space;

said entraining means including an annular carrying body having a plurality of carrying rods extending radially outwardly;

said carrying rods having respective outer free ends;

a plurality of rubber-elastic bodies attached to corresponding ones of said outer free ends; and,

each of said rubber-elastic bodies being arranged at a spacing from the next adjacent one of said rods.

25. The starting device of claim 24, said carrying body, said carrying rods and said rubber-elastic bodies being made of elastic plastic.

26. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being electrically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said clutch drum having a bearing position thereon and said carrier having a projection formed thereon; and,

said entraining means including: an annularly-shaped rubber band; a plurality of carrying rings attached to said rubber band and disposed one next to the other; and, said rubber band being held between said bearing position and said projection.

27. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said clutch drum having a radial support surface;

said entraining means being coil spring means disposed in said receiving space along at least a segment of a circle concentric to said axis;

said carrier having a projection formed thereon; and,

said coil spring means being clamped between said radial support surface and said projection.

28. The starting device of claim 27, said coil spring means comprising a plurality of individual coil springs and a plurality of slide bodies; and, one of said slide bodies being disposed between each two mutually adjacent ones of said slide bodies.

29. The starting device of claim 28, said individual coil springs being respective barrel coil springs.

30. The starting device of claim 27, said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and, said clutch drum having a base wall and a side wall extending from said base wall to define said circularly-shaped receiving space.

31. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and,

said entraining means including: an entraining strut formed on said carrier; and, a plastic folded strip spring braced on said entraining strut and connected to said clutch drum.

32. The starting device of claim 31, said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and, said clutch drum having a base wall and a side wall extending from said base wall to define said circularly-shaped receiving space.

33. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means; and,

said entraining means including: an elastic pull band having first and second ends connected at radially opposite locations, respectively, of said clutch drum; and, a lug mounted on said carrier and said pull band being in pull contact with said lug so as to pass over said lug.

34. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member;

said entraining means being elastically deformable to compensate for the fluctuations of said starting torque;

said clutch drum having a circularly-shaped receiving space formed therein for holding said entraining means;

said carrier having a base and said clutch drum having an inner end face; and,

said entraining means including an annular rubber-elastic layer connected to said base and said inner end face by vulcanizing said layer to said base and said inner end face.

35. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

a spiral spring for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

said spiral spring having first and second ends connected to said clutch drum and said carrier, respectively;

said clutch drum having a circularly-shaped receiving space formed therein for holding said spiral spring;

said clutch drum having a base wall and a side wall extending from said base wall to define said circularly-shaped receiving space;

catch means mounted on said carrier and being displaceable in response to said rotational movement from a rest position into an engaging position wherein said catch means engages and transmits said rotational movement to said clutch member; and,

said spiral spring being elastically deformable to compensate for the fluctuations of said starting torque.

36. A starting device for applying a starting torque to the shaft of an internal combustion engine with the engine developing a reaction torque during starting which causes said starting torque to fluctuate, the starting device comprising:

a housing;

a clutch drum rotatably journalled in said housing and defining an axis of rotation;

means for manually imparting a rotational movement to said clutch drum;

a clutch member fixedly mounted to the engine shaft for rotation therewith;

a carrier rotatably mounted in said housing so as to be rotatable about said axis;

elastomer entraining means for connecting said clutch drum to said carrier for transmitting the rotational movement of said clutch drum to said carrier;

said clutch drum having a circularly-shaped receiving space formed therein for holding said elastomer entraining means;

said clutch drum having a base wall and a side wall extending from said base wall to define said circularly-shaped receiving space;

catch means mounted on said carrier and said catch means including a mount on said carrier and two pawls pivotally mounted on said mount so as to be displaceable in response to said rotational movement from a rest position into an engaging position wherein said two pawls engage and transmit said rotational movement to said clutch member; and,

said elastomer entraining means being elastically deformable to compensate for the fluctuations of said starting torque.

* * * * *

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(12) **United States Patent**
Akaike et al.

(10) **Patent No.: US 6,508,220 B1**
(45) **Date of Patent: Jan. 21, 2003**

(54) STARTER

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(73) Assignee: **Kioritz Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Aug. 16, 2000**

(30) **Foreign Application Priority Data**

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Aug. 25, 1999 (JP) 11-238642
Dec. 7, 1999 (JP) 11-347866

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(52) **U.S. Cl.** ..... **123/185.14**; 123/185.3; 185/41 A
(58) **Field of Search** ..... 123/185.14, 185.2, 123/185.3, 185.4; 185/39, 40 R, 41 R, 41 A, 41 C

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Primary Examiner—Andrew M. Dolinar
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A starter that is capable of minimizing fluctuations in the pulling force of a starter rope so as to make it possible to perform a smooth pulling operation when starting an internal combustion engine includes a driving section (A), a driven section (B), and a buffering/power-accumulating device (15) interposed between the driving section (A) and the driven section (B).

10 Claims, 8 Drawing Sheets

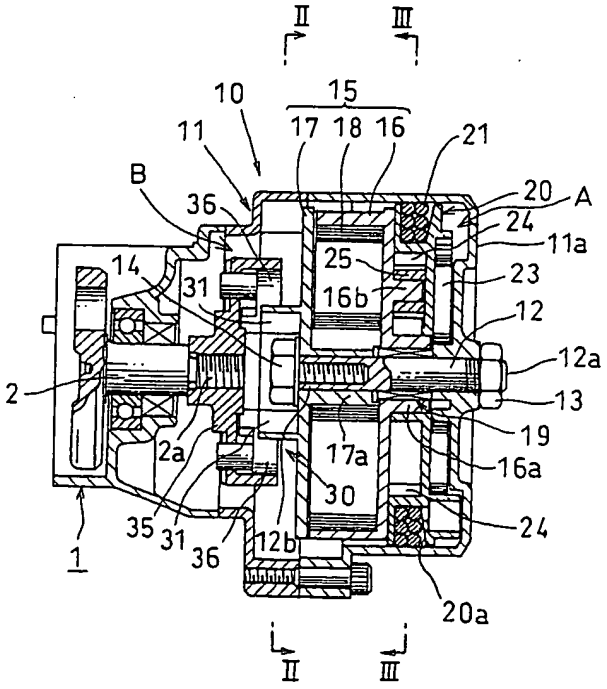


FIG. 1

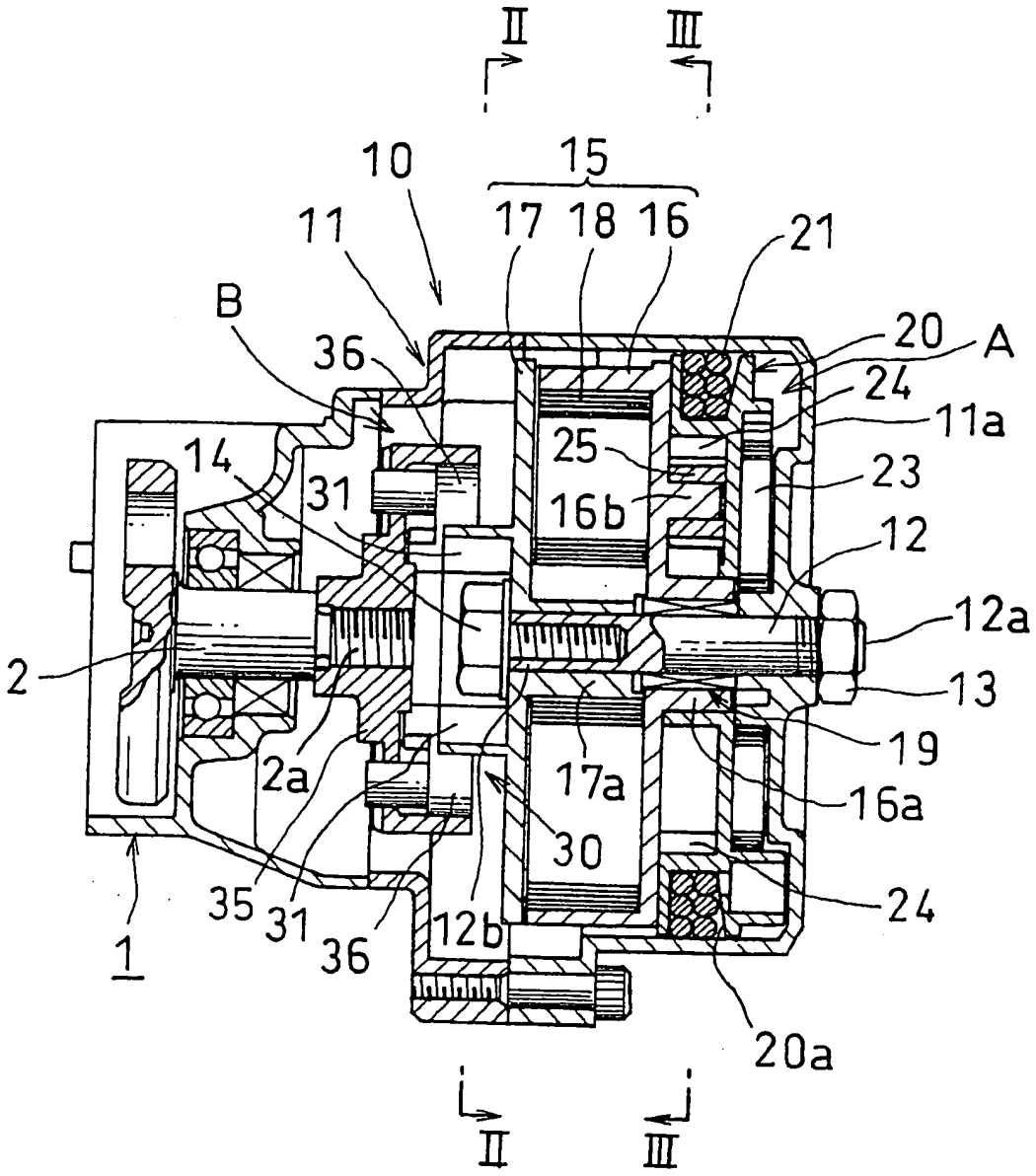

II
III
10
15
17
18
16
11
21
B
36
20
A
24
11a
25
23
14
31
16b
12
12a
2
13
19
17a
2a
16a
30
24
35
31
36
12b
1
20a
II
III

FIG. 2

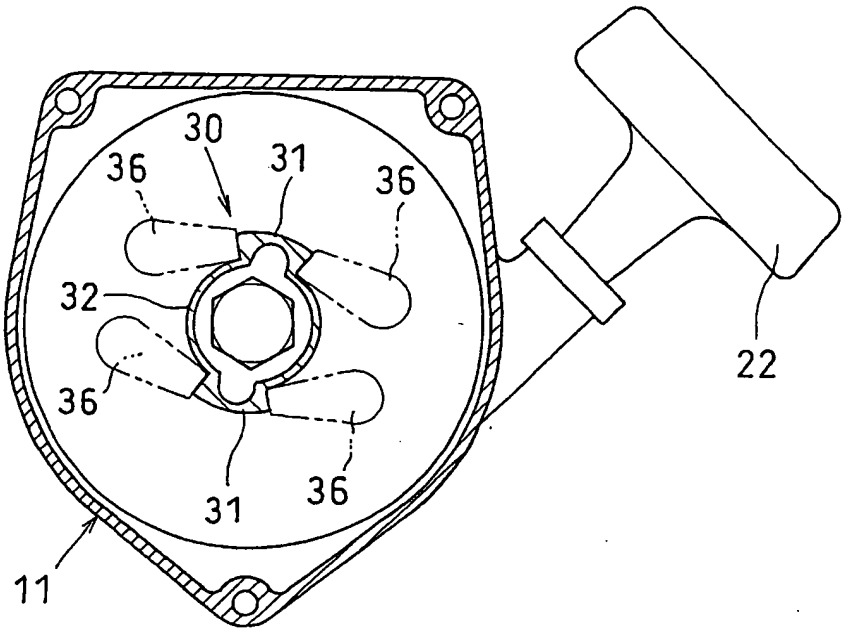

30
36
31
36
32
36
31
36
22
11

FIG. 3

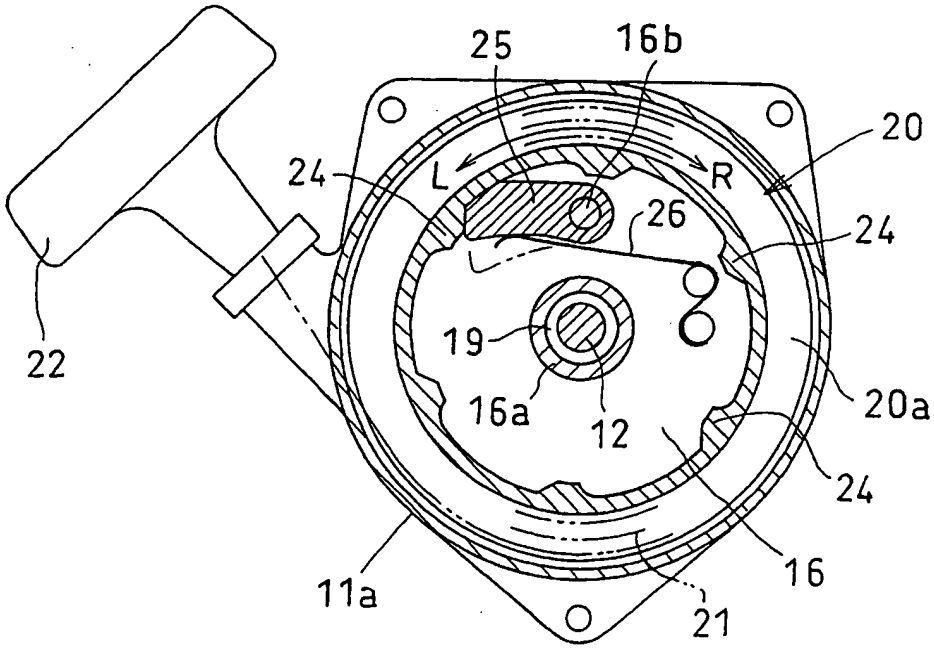

25
16b
20
24
L
R
26
24
19
16a
12
20a
24
22
16
11a
21

FIG. 4 (a)

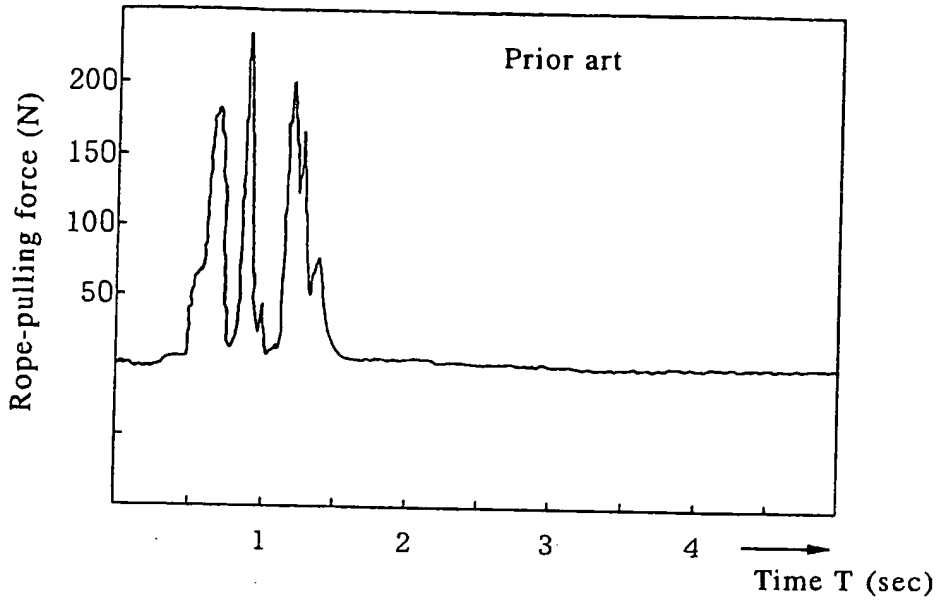

Prior art
Rope-pulling force (N)
200
150
100
50
1
2
3
4
Time T (sec)

FIG. 4 (b)

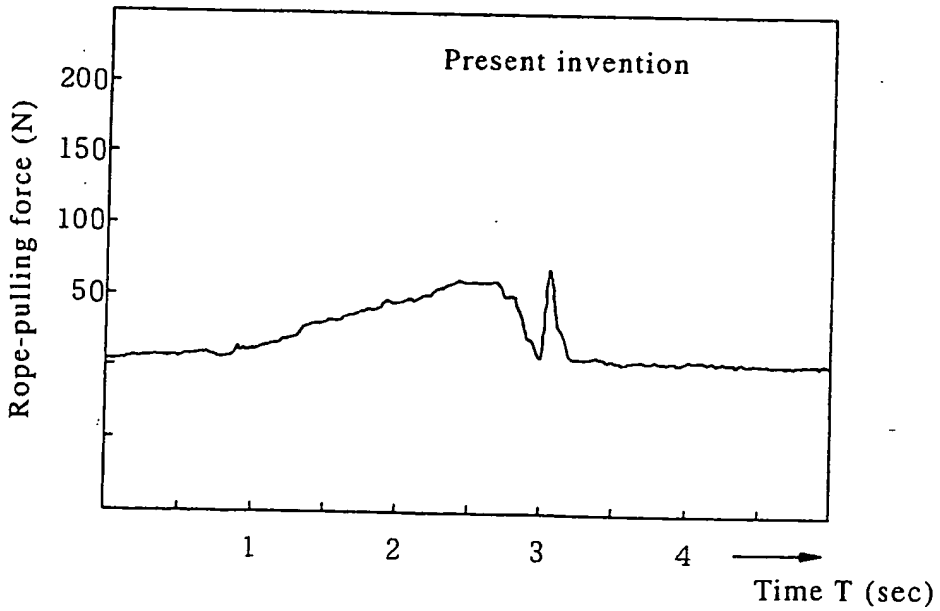

Present invention
Rope-pulling force (N)
200
150
100
50
1
2
3
4
Time T (sec)

FIG. 5

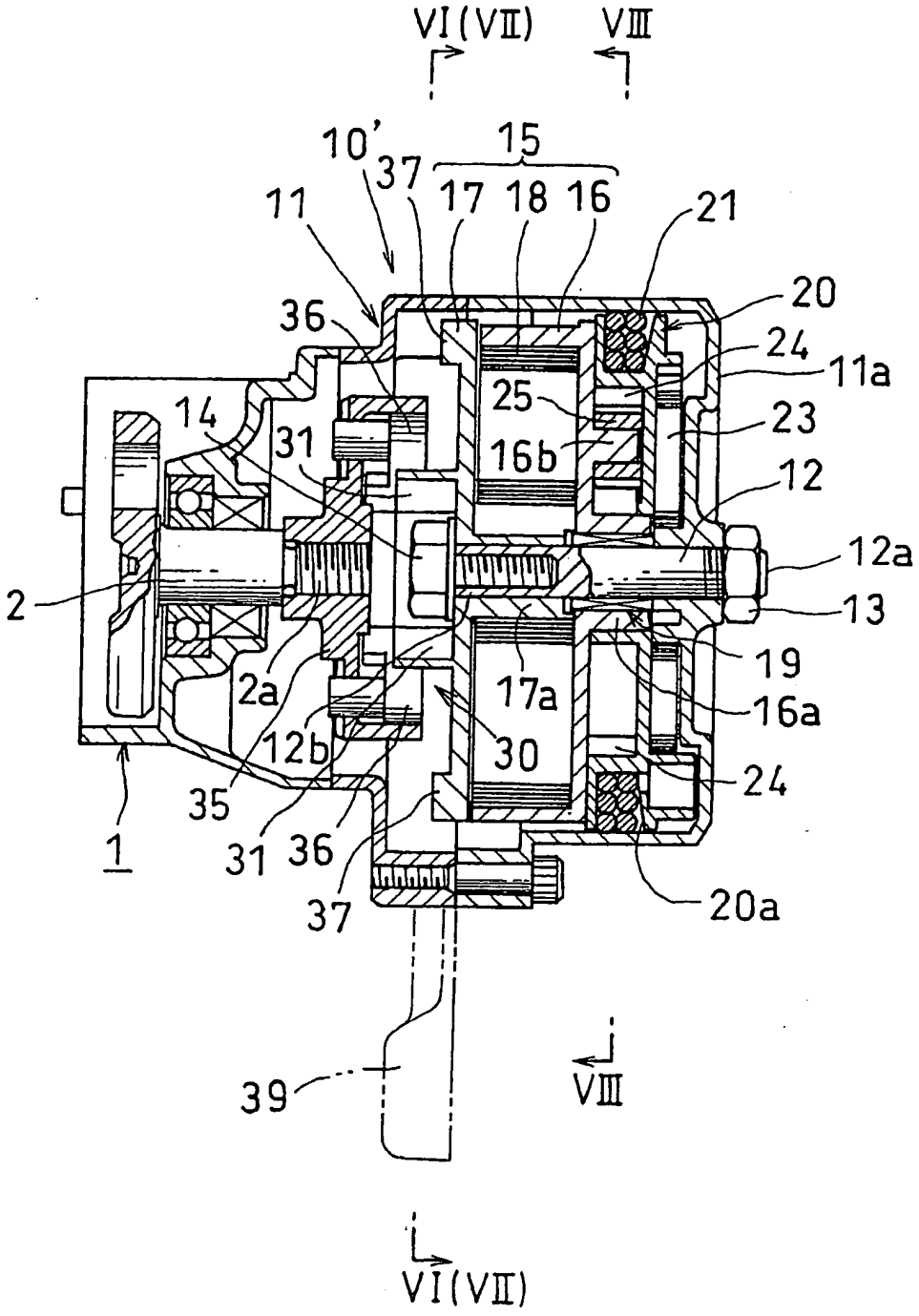

VI(VII)
VIII
10'
15
37
17
18
16
11
21
20
36
24
11a
25
23
14
31
16b
12
12a
2
13
19
2a
17a
16a
12b
30
24
35
1
31
36
37
20a
39
VIII
VI(VII)

FIG. 6

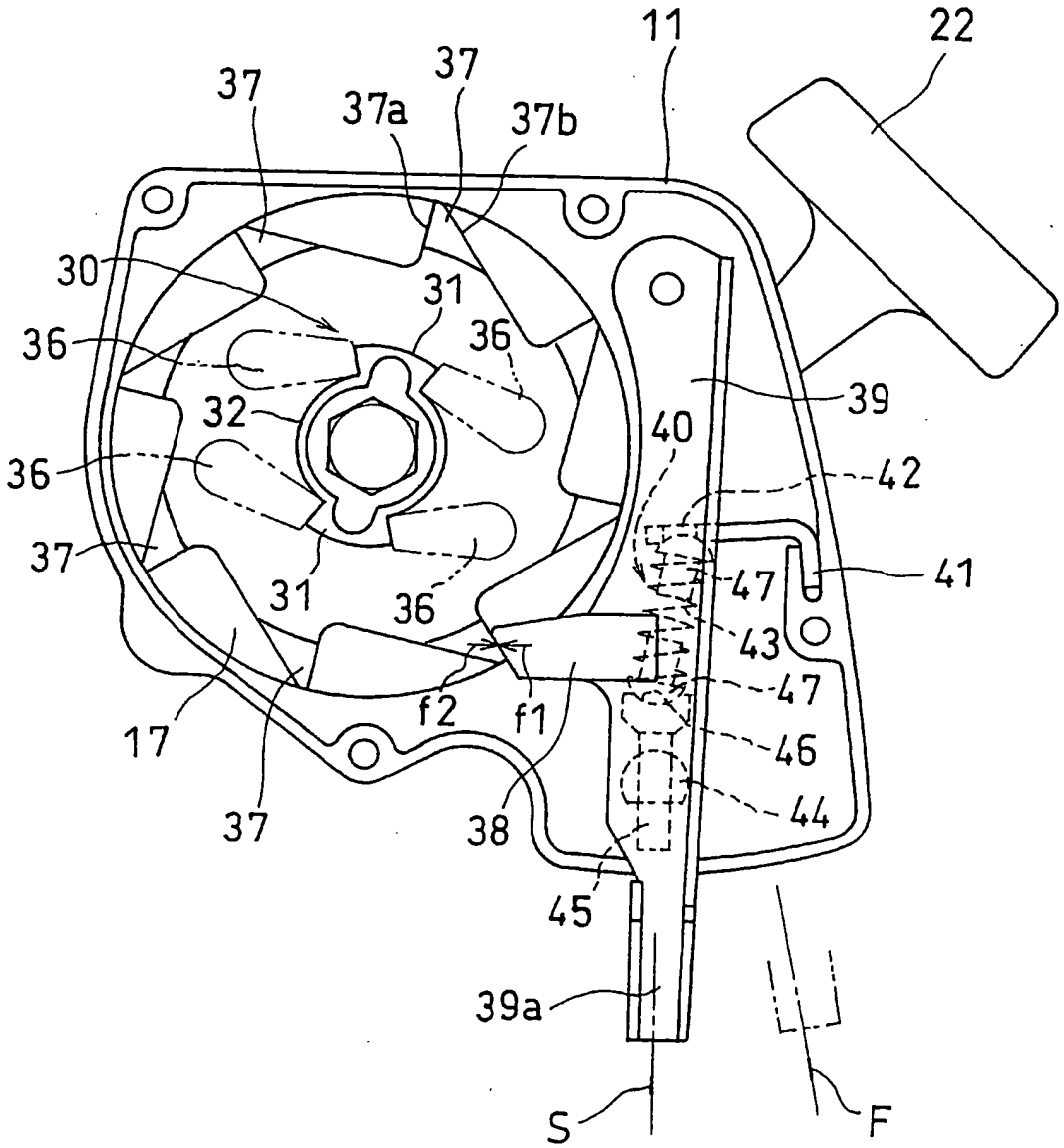
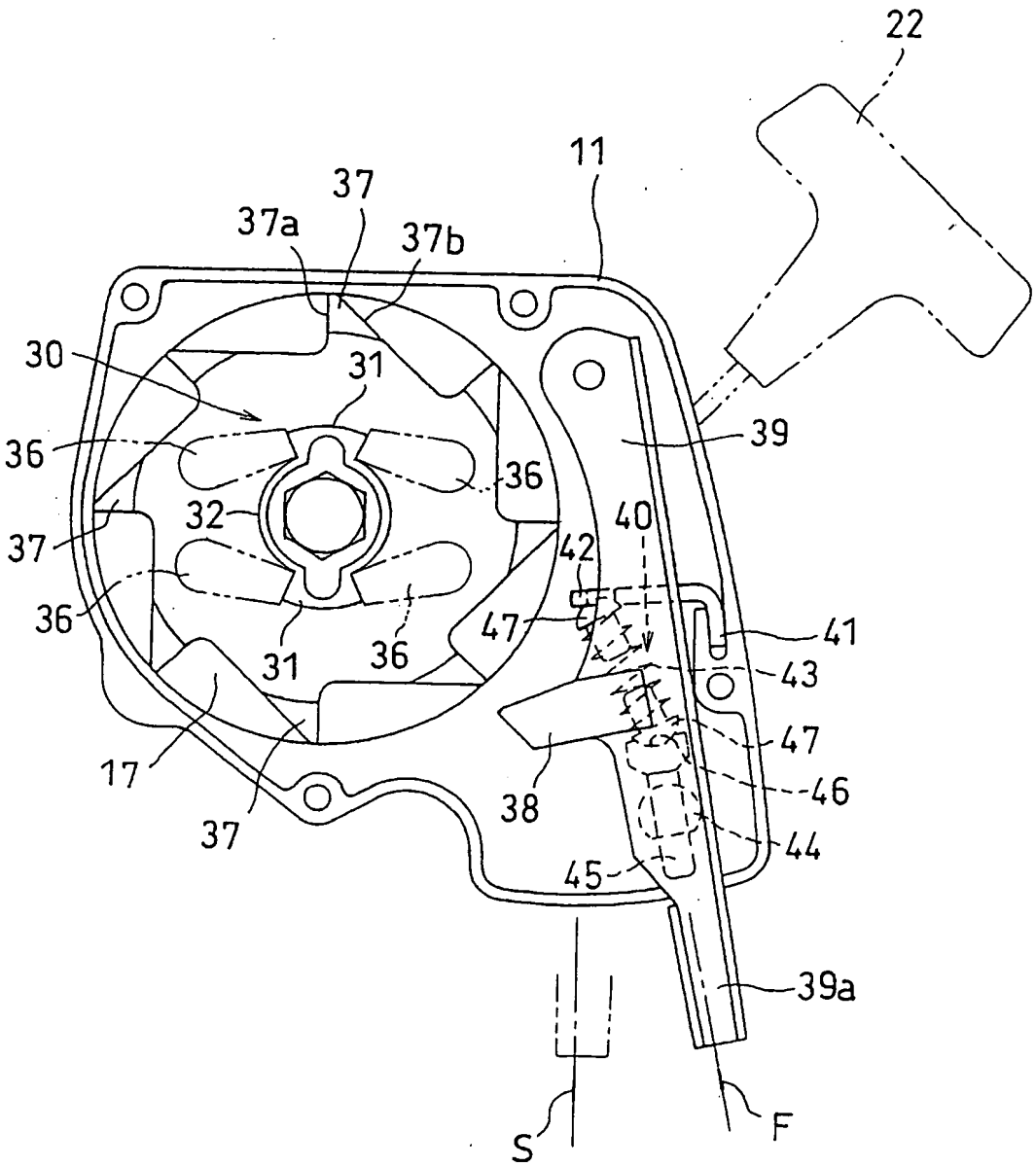

11
22
37
37
37a
37b
30
31
36
36
32
36
39
40
42
37
31
36
47
41
43
47
f2
f1
46
17
44
37
38
45
39a
S
F

FIG. 7


22
11
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37a
37b
30
31
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32
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17
46
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38
44
45
39a
S
F

FIG. 8

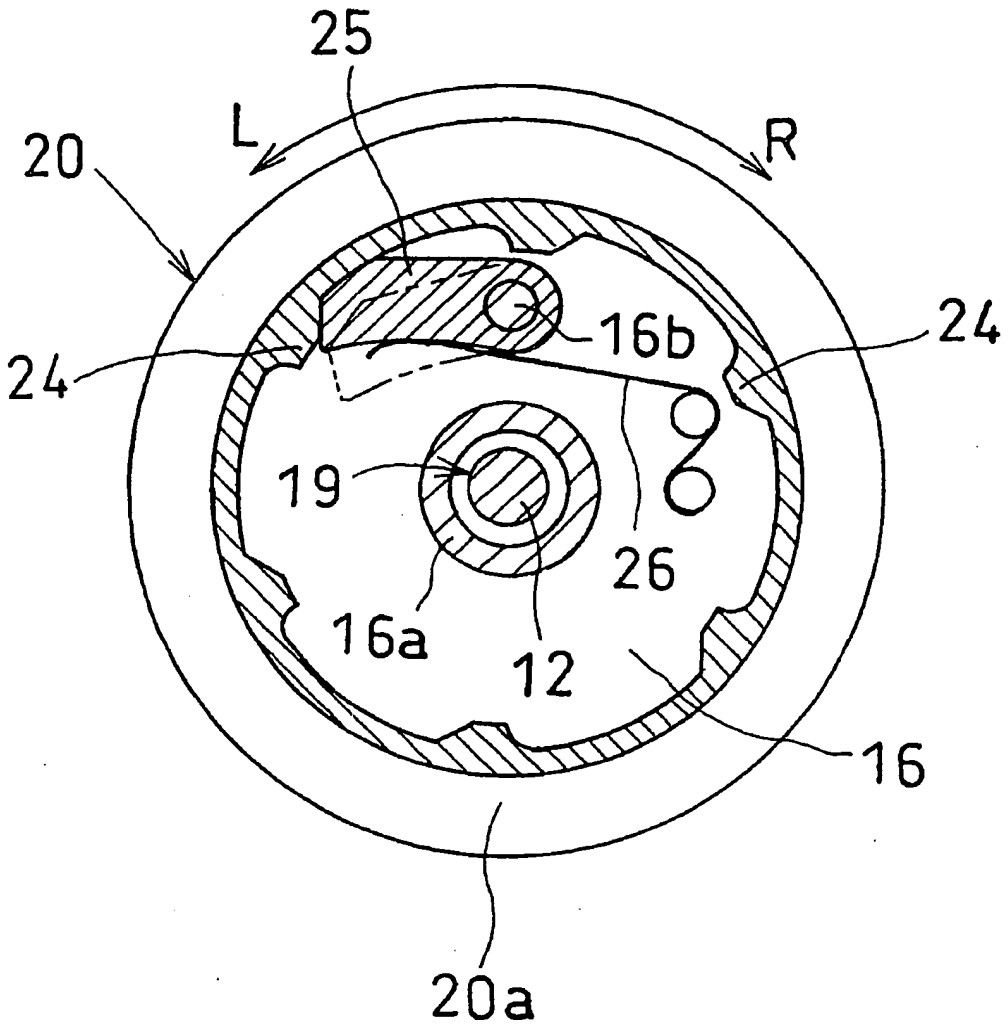


FIG. 9 (a)

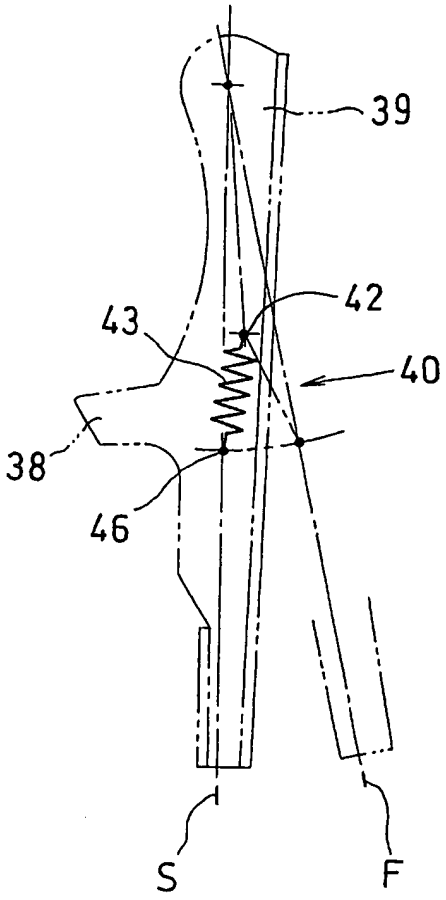
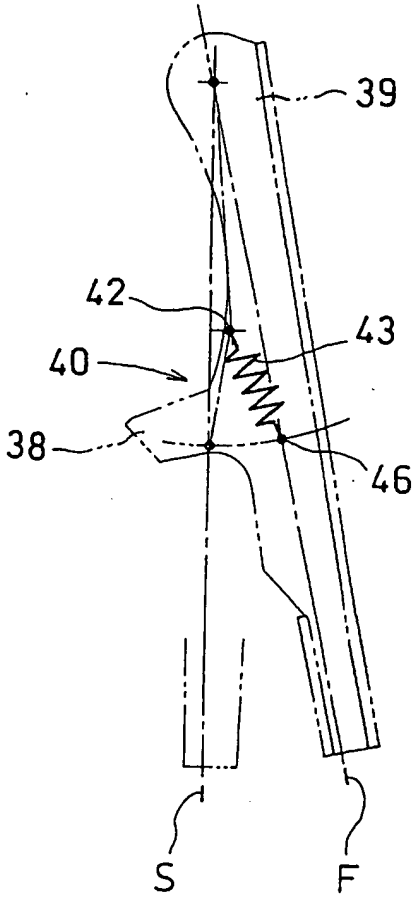


FIG. 9 (b)



STARTER

BACKGROUND OF THE INVENTION

The present invention relates to a starter for an internal combustion engine and, in particular, to a starter wherein fluctuations in the force required to pull the starter rope can be minimized, thereby enabling the starter rope to be smoothly pulled and providing excellent performance of the starter. Specifically, the present invention relates to a power-accumulation type starter wherein the rotational force of the starter is accumulated by means of a spiral spring for starting an internal combustion engine.

In some conventional manual starters for an internal combustion engine, the starting of the internal combustion engine is performed through a process wherein the starter rope is pulled to rotate the rope pulley, and the rotation of the rope pulley is directly transmitted to the crank shaft of the engine so as to start the engine. There is also known a starter wherein a decompressor is employed with a view to minimizing the force for pulling a starter rope handle.

There is also known, as another type of conventional starter for internal combustion engines, a power-accumulation type starter wherein a spiral spring is manually wound up so as to accumulate the rotational force, and the power thus accumulated is then released all at once. According to the conventional starter, a pulley is rotated by pulling a starter rope by means of the starter rope handle, and the rotational force of the pulley is accumulated in the spiral spring, the rotational force being subsequently transmitted to the crank shaft of the internal combustion engine through an actuating pulley so as to start the engine.

The conventional starter constructed as described above is, however, accompanied with a problem in that the starter rope handle for pulling the starter rope is required to be pulled at a relatively high speed and for a long distance, so that it is difficult for a person having weak physical strength to easily start the engine. Moreover, since the rope handle-pulling operation is accompanied with a large fluctuation in the pulling force due to the load to be imposed by the internal combustion engine side in accordance with the rotation of the crank shaft, it is difficult to perform a smooth pulling operation. Hence, it is difficult for a person having weak physical strength to easily start the engine. When a decompressor is employed for the purpose of alleviating the pulling force, an unburned air-fuel mixture is allowed to be released to the external atmosphere, thus causing environmental problems.

On the other hand, a starter having a mechanism wherein the actuating pulley is arranged to be automatically rotated as the rotational force is accumulated up to a predetermined degree is accompanied with problems that the structure thereof becomes complicated, thus making the starter larger in size and weight, and hence unsuitable for use in a small working machine.

BRIEF SUMMARY OF THE INVENTION

The present invention has been made to solve the aforementioned problems. Therefore, it is an object of the present invention to provide a starter which is capable of minimizing fluctuations in the pulling force of the rope handle so as to make it possible to perform a smooth pulling operation and so that the starter can be easily manipulated even by a person having weak physical strength in starting the engine. Another object of the present invention to provide a starter which is excellent in its performance in starting an internal combustion engine and free from environmental problems.

A further object of the present invention is to provide a power-accumulation type starter which, in contrast to the conventional recoiling rope type starter, is capable of easily and reliably starting the engine, irrespective of the pulling speed as well as pulling distance of the starter rope by means of the rope handle, while allowing the starter to be employed in the same manner as the conventional recoil starter by canceling a power accumulation mechanism if the accumulation of rotational force is not required.

A further object of the present invention is to provide a power-accumulation type starter that is simple in construction and light in weight, thereby making it suited for use in a small working machine, that can be easily operated to start the engine while a machine equipped with an internal combustion engine having the starter of the present invention is carried on an operator's back by locating a rope handle and a start reset lever near the operator's hands. In addition, if accumulation of rotational force in a spring is not required to start the engine, the starter of the present invention can be used as a recoil type starter having a mechanism for buffering the load to be imposed thereon from the engine side.

With a view to attaining the aforementioned objects, there is provided, in accordance with the present invention, a starter comprising a driving section, a driven section, and a buffering/power-accumulating device interposed between the driving section and the driven section. The buffering/power-accumulating device is enabled, during the driving process of the driving section, to buffer a load from an engine side and to accumulate the power supplied by the driving of the driving section, and the driven section is arranged to be actuated by the accumulated power.

With the starter of the present invention having the aforementioned structure, since the buffering/power-accumulating device is interposed between the starter rope constituting the driving section and the crank shaft of the internal combustion engine constituting the driven section, all of the force for pulling the starter rope is not directly related to the starting of the engine, but part of the pulling force of the starter rope is accumulated in the spiral spring mechanism in an initial part of the process of recoiling, and the accumulated pulling force is afterward combined with the actual pulling force of the starter rope in a later part of the process of recoiling, thereby presenting a resultant force to start the engine. Therefore, even if the force for pulling the starter rope is weak, the engine can be reliably started. In particular, the buffering/power-accumulating device is capable of not only functioning to buffer and accumulate the pulling force of the starter rope but also providing an additional force for starting the engine by releasing the power accumulated therein.

In a preferred embodiment of the present invention, the driving section comprises a reel, and the driven section comprises an interlocking pulley provided with a transmission mechanism through which the interlocking pulley is linked to the driving section. The buffering/power-accumulating device may be constituted by a spiral spring mechanism in which a spiral spring is interposed between a spiral spring box disposed on the driving section side and an actuating pulley disposed on the driven section side. An input device is provided to unidirectionally rotate the spiral spring box. In a preferred embodiment of the present invention, the input device for unidirectionally rotating the spiral spring box includes a one-way clutch, and the transmission mechanism is a centrifugal clutch which is constituted by engaging projections and start-up claws pivotally supported by the interlocking pulley so as to engage with the

engaging projections, thereby enabling the rotation of the reel to be transmitted through the spiral spring mechanism to the interlocking pulley linked with the crank shaft of the internal combustion engine.

According to the starter constructed as described above and representing one embodiment of the present invention, the reel is manually rotated by a starter rope wound onto a starter pulley, and the resultant rotational force is once transmitted to the spiral spring mechanism before it is utilized for the rotation of the actuating pulley, so that the fluctuating load due to the working strokes of the internal combustion engine can be absorbed by the spiral spring mechanism, thereby making it possible to smoothly pull the rope handle. Therefore, the internal combustion engine can be easily started by even a person who has weak physical strength. Further, since the crank shaft is rotated through the spiral spring mechanism, the internal combustion engine can be started always with an optimum timing in terms of starting conditions, and the performance of the starter can be improved. Also, since the spiral spring mechanism is enabled to unidirectionally rotate by making use of the one-way clutch, the starter can be reliably operated and also can be made small in size.

A power-accumulation type starter, according to some embodiments of the present invention, has a spiral spring power-accumulating mechanism, a manual reel for accumulating a rotational force in the spiral spring power-accumulating mechanism, a reset lever having a stopper for stopping the rotation of the output side of the spiral spring power-accumulating mechanism to thereby retain the rotational force accumulated until a predetermined torque is reached, and a transmitting mechanism for transmitting an accumulated rotational force to a crank shaft of an internal combustion engine when the stopper is released from stopping the rotation of the output side.

In a preferred embodiment of the power-accumulation type starter according to the present invention, the reset lever is movable between a stop position and a free position by means of an instantaneous switching mechanism, and the instantaneous switching mechanism is provided with a spring member which is interposed between an anchoring portion and the reset lever.

In a preferred embodiment of the power-accumulation type starter according to the present invention, the spiral spring power-accumulating mechanism is featured in that it is constituted by a spiral spring which is interposed between a spiral spring box disposed on the input side and an actuating pulley disposed on the output side, that a rope groove for winding a rope is formed on an outer periphery of the manual reel, and that the spiral spring power-accumulating mechanism and the manual reel are coaxially mounted, and the reset lever is enabled to be manually moved from the stop position to the free position.

With the power accumulation type starter of the present invention that is constructed as described above, the rotational force can be effectively accumulated in the spiral spring power-accumulating mechanism even if the speed with which the rope handle is pulled is slow and even if the pulling distance is short. Further, since the rotational force is transmitted to the crank shaft so as to start the engine in a state where the torque of the rotational force becomes sufficiently high, the engine can be very easily started. Additionally, when the stopper is arranged to be instantaneously released from stopping the power-accumulating mechanism at the moment when the rotational force of the actuating pulley has reached a predetermined value of torque, the engine can be reliably started. Furthermore, since a decompressor for facilitating the starting operation is not required to be used, there will be no environmental problem resulting from the release of the unburned air-fuel mixture.

Since the instantaneous switching mechanism according to the present invention is provided with a spring member which is interposed between the fixed portion of the switching mechanism and the reset lever, the construction thereof can be simplified and the operation thereof can be reliably performed. Further, since the spiral spring power-accumulating mechanism and the manual reel are coaxially mounted, the construction of the instantaneous switching mechanism can be simplified and kept small in size. Further, the power-accumulation type starter can be used as an ordinary recoil starter without making use of the spiral spring power-accumulating mechanism. In this case, the spiral spring will function as a buffering member, thereby making it possible to alleviate an increased load resulting from the compression stroke of the internal combustion engine.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. **1** is a cross-sectional view of a starter representing one embodiment of the present invention;

FIG. **2** is a sectional view taken along the line II—II in FIG. **1**;

FIG. **3** is a sectional view taken along the line III—III in FIG. **1**;

FIGS. **4***a* and **4***b* are graphs illustrating a relationship between the rope-pulling force and the rope-pulling time in a starter according to the prior art and according to the present invention, respectively;

FIG. **5** is a cross-sectional view of a starter representing another embodiment of the present invention;

FIG. **6** is a sectional view taken along the line VI—VI in FIG. **5**, representing the stop position of the reset lever;

FIG. **7** is a sectional view taken along the line VII—VII in FIG. **5**, representing the free position of the reset lever;

FIG. **8** is a sectional view taken along the line VIII—VIII in FIG. **5**, wherein the case and rope are omitted; and

FIGS. **9***a* and **9***b* are schematic views each illustrating the operation of an instantaneous switching mechanism.

DETAILED DESCRIPTION OF THE INVENTION

Next, one embodiment of a starter according to the present invention will be explained with reference to FIGS. **1** to **3** of the drawings. The starter **10** is located close to one end **2***a* of the crankshaft **2** of an internal combustion engine **1**, such as a small air-cooled internal combustion engine. The starter **10** comprises a case **11**, which is adapted to be mounted on one sidewall of the internal combustion engine **1**. The case **11** is composed of two parts, one of which is a cup-like case member **11***a* to a central bottom portion of which one end **12***a* of a fixing shaft **12** is fastened by means of a nut **13**. The starter **10** has a driving section A, a driven section B, and a spiral spring mechanism **15** functioning as a buffering/power-accumulating device and between a manual reel **20**, constituting the driving section A, and an interlocking pulley **35**, constituting the driven section B. Thus, the rotation of the manual reel **20** can be transmitted via the spiral spring mechanism **15** and the interlocking pulley **35** to the crankshaft **2** of the internal combustion engine **1**.

The spiral spring mechanism 15 comprises a spiral spring 18 which is interposed between a spiral spring box 16, constituting an input side, and an actuating pulley 17, constituting an output side. The spiral spring box 16 and the actuating pulley 17 are disposed coaxially with each other and are rotatable relative to each other. Though not shown in detail in FIGS. 1 to 3, the outer end portion of the spiral spring 18 is attached in a well-known manner to the spiral spring box 16, while the inner end portion of the spiral spring 18 is attached, also in a well-known manner, to the actuating pulley 17, so that when either one of the spiral spring box 16 and the actuating pulley 17 is rotated relative to the other, the rotational force thereof is automatically supplied to the other.

The spiral spring box 16 of the spiral spring mechanism 15 is provided at the center thereof with a cylindrical portion 16*a*. A one-way clutch 19 is interposed between the inner peripheral wall of the cylindrical portion 16*a* and the outer peripheral wall of the fixing shaft 12, so that the spiral spring box 16 is supported by the fixing shaft 12 so as to be rotated unidirectionally about the fixing shaft 12. The actuating pulley 17 is provided at the center thereof with a cylindrical portion 17*a* which is received for rotation on the fixing shaft 12. A retaining bolt 14 is screwed into the fixing shaft 12 from the other end 12*b* of the fixing shaft 12 so as to support the actuating pulley 17 axially while allowing it to rotate about the fixing shaft 12.

The reel 20 is interposed between the cup-like case member 11*a* and the spiral spring box 16 and is rotatably supported on the outer periphery of the cylindrical portion 16*a* of the spiral spring box 16. The reel 20 is a rope pulley that can be manually rotated and has on its outer periphery an annular groove 20*a* so as to enable a rope 21 to be wound around it. In the same manner as in the case of the conventional recoiling rope type starter, one end of the rope 21 is fastened to a bottom portion of the groove 20*a*, while the other end of the rope 21 extends out of the cup-like case member 11*a* and is attached to a rope handle 22. Between the reel 20 and the cup-like case member 11*a*, there is interposed a recoil spiral spring 23, the outer end of which is attached to the rope reel 20 and the inner end of which is attached to a central portion of the cup-like case member 11*a*. The reel 20 is arranged to be rotated by pulling the rope 21 and then to be allowed to return to the original position on account of the restoring force of the recoil spiral spring 23, thereby enabling the rope 21 to be automatically wound up onto the reel 20.

Next, the interlocking mechanism between the rope reel 20 and the spiral spring box 16 will be explained with reference to FIGS. 1 and 3. Six engaging protrusions 24 are formed on the inner periphery of the rope pulley 20. A pivot pin 16*b* that protrudes toward the rope pulley 20 is integrally attached to the side wall of the spiral spring box 16 which faces the rope pulley 20, and an interlocking claw 25 is rotatably supported on the pivot pin 16*b*. The interlocking claw 25 is arranged to be elastically engaged with one of the engaging protrusions 24 by means of a pushing spring 26 urged toward the external direction. Therefore, when the rope pulley 20 is rotated in one direction R (the clockwise direction in FIG. 3), the spiral spring box 16 is also interlockingly rotated in the same direction R. On the other hand, when the rope pulley 20 is rotated in the opposite direction L (the counter-clockwise direction in FIG. 3), the interlocking claw 25 is pushed radially inwardly by the protrusions 24, thereby causing the interlocking claw 25 to pivot in the counter-clockwise direction about the pin 16*b*, thus to run idly.

The actuating pulley 17 is provided at the central portion thereof with a pair of engaging projections 31, which constitute one of the members of a transmission mechanism 30 disposed diametrically opposite each other relative to the axis of the crankshaft 2 of the internal combustion engine 1. The engaging projections 31 are joined to each other via an annular wall portion 32. On one side of the internal combustion engine 1 is disposed the interlocking pulley 35, which is fixed to the one end 2*a* of the crankshaft 2. Four start-up claws 36 constituting the other member of the transmission mechanism 30 are pivotally supported by the interlocking pulley 35. Each of these start-up claws 36 is ordinarily urged in the inward direction by means of a spring (not shown) and hence engaged with the engaging projections 31. However, when the internal combustion engine 1 is started, these start-up claws 36 are caused to pivot in the radially outward direction by centrifugal force so as to be disengaged from the engaging projections 31. That is, the start-up claws 36 are constructed to function as a centrifugal clutch.

As for the number of these start-up claws 36, although there is no particular limitation as long as there is at least one start-up 36 claw, four start-up claws 36 are included in this embodiment in view of suitably dispersing the shock generated at the moment of actuating the start-up claws 36 as well as in view of ensuring the actuation of the start-up claws 36.

Next, the operation of the starter constructed according to the invention will be explained. When the internal combustion engine 1 is to be started, the rope handle 22 is manually pulled so as to rotate the rope pulley 20. The rotation of the rope pulley 20 is transmitted to the spiral spring box 16 through the interlocking claw 25, which is resiliently engaged with one of the engaging protrusions 24 (see FIG. 3), thereby allowing the spiral spring box 16 to be rotated synchronously with the rotation of the rope pulley 20. When the pulling force of the rope handle 22 stops, the rope pulley 20 is allowed to reversibly rotate and return to the original position due to the accumulated power (restoring force) of the recoil spiral spring 23. As a result, the rope 21 is automatically wound up. However, the spiral spring box 16 is prevented from rotating reversibly due to the one-way clutch 19, thereby supplying the spiral spring 18 with a rotational force. Since the pulling force of the rope handle 22 required on this occasion can be such that it is sufficient to supply the spiral spring 18 with a rotational force, the fluctuation of the load can be minimized, thereby realizing a smooth pulling operation of the rope 21.

The rotational force supplied to the spiral spring 18 is then transmitted to the actuating pulley 17 via the cylindrical portion 17*a* to which the inner end of the spiral spring 18 is attached. The rotational force supplied to the actuating pulley 17 is then transmitted via the start-up claws 36, which are engaged with the engaging projections 31, to the interlocking pulley 35 and hence to the crank shaft 2. However, since the load for causing compression of the air-fuel mixture in the internal combustion engine 1 is large, and additionally, since the load is caused to fluctuate during a full rotation of the crank shaft 2, the rotation of the interlocking pulley 35 afforded by the aforementioned rotational force is caused to stop once at the position where the load is large (in the vicinity of the top dead center of the suction stroke).

When the rope handle 22 is pulled again to rotate the rope pulley 20, the spiral spring 18 is further supplied with an additional rotational force, thereby further increasing the torque acting to rotate the actuating pulley 17. Even in this

case, due to the presence of the spiral spring **18**, the fluctuation of force in pulling the rope handle **22** can be minimized, thereby smoothing the pulling operation. When the magnitude of torque applied to the actuating pulley **17** becomes larger than the load imposed by the internal combustion engine **1**, the internal combustion engine **1** is caused to start rotating by application of the torque of the spiral spring **18** to the crank shaft **2**. As described above, since the rotation of the internal combustion engine I is started from the state where the piston is stopped in the vicinity of the top dead center of the suction stroke, the engine **1** can be shifted immediately to the combustion/power stroke from the suction stroke, which makes it possible to start the internal combustion engine **1** with preferred timing and high reliability.

When the internal combustion engine **1** has started, the interlocking pulley **35** is caused to rotate by the driving force from the crank shaft **2** side. When the rotational speed of the interlocking pulley **35** exceeds a predetermined value, the start-up claws **36** are caused to pivot radially outwardly, due to the centrifugal force, thereby allowing the start-up claws **36** to be disengaged from the engaging projections **31**. As a result, the internal combustion engine **1** is dissociated from the starter **10**, thereby enabling the internal combustion engine **1** to continue the stable rotation thereof.

According to this embodiment, on the occasion of starting the internal combustion engine **1**, the value of torque of the spiral spring mechanism **15** becomes large at the moment when the load of the internal combustion engine **1** is increased, so that the internal combustion engine **1** can be started with optimum timing and high reliability.

Comparative experiments have been conducted in which the starter according to the above-described embodiment of FIGS. **1** to **3** were compared with the conventional starter (which is arranged such that the rope reel is rotated by pulling a starter rope so as to directly transmit the rotation of the rope pulley to the crank shaft of an engine on the occasion of starting the engine).

In these experiments, three kinds of a small air-cooled internal combustion engine, each differing in displacement (Example 1, Example 2 and Example 3) are employed to investigate the force required for pulling a starter rope, the restartability, the initial startability, the relationship between the number of crankings and the initial rotational speed, and the relationship between the pulling force and the pulling time.

The results of the experiments on the starter according to the embodiment and the conventional starter are shown in Tables 1 to 3 and in FIGS. 4(*a*) and 4(*b*).

TABLE 1

Ex. 1 Displacement 39.7 mL (compression pressure cold 1.41 MPa)

Recoil-pulling force		Prior art	Present invention
Non Firing	Max	166N	94.3N
	Min	86.7N	86.3N
	$\bar{X}$(n = 10)	117N	90.0N
Firing	Max	148N	101N
	Min	169N	80.7N
	$\bar{X}$(n = 10)	159N	91.5N
	Restartability (complete explosion)	10/10 times	10/10 times
Initial startability	25° C.	2 times (194, 196N)	2 times (109, 88.8N)
	5° C.	9 times	9 times
	40° C.	(195~102N) 2 times (114, 86.1N)	(122~107N) 1 time (106N)

Number of crankings/ Initial rotational speed	Prior art	Present invention
Ordinary pulling	7 times/666r/min	13 times/780r/min
Slow pulling	6 times/600r/min	8 times/612r/min
Quick pulling	10 times/792r/min	—

TABLE 2

Ex. 2 Displacement 21.2 mL (compression pressure cold 0.87 MPa)

		Prior art	Present invention
Recoil-pulling force (Firing)	Max	112N	51.7N
	Min	72.2N	43.0N
	$\bar{X}$(n = 10)	91.7N	47.4N
	Restartability (complete explosion)	8/11 times	10/10 times
Initial startability	29° C.	3 times (109~102N)	2 times (62.4, 52.4N)

Number of crankings/ Initial rotational speed	Prior art	Present invention
Ordinary pulling	6 times/1272r/min	4 times/1536r/min
Slow pulling	5 times/870r/min	2 times/923r/min
Quick pulling	7 times/1380r/min	6 times/1687r/min

TABLE 3

Ex. 3 Displacement 25.4 mL (compression pressure cold 0.91~0.93 MPa)

		Prior art	Present invention
Recoil-pulling force (Firing)	Max	195N	64.3N
	Min	69.9N	60.8N
	$\bar{X}$(n = 10)	98.5N	62.4N
	Restartability (complete explosion)	7/10 times	10/10 times
Initial startability	29° C.	7 times (143~90.4N)	1 time (60.8N)

Number of crankings/ Initial rotational speed	Prior art	Present invention
Ordinary pulling	6 times/1302r/min	7 times/1740r/min
Slow pulling	4 times/936r/min	5 times/1500r/min
Quick pulling	10 times/1440r/min	11 times/1980r/min

As Tables 1 to 3 and FIGS. 4(*a*) and (*b*) show, the starter according to the embodiment was found as requiring a lesser pulling force on the starter rope as compared with that of the conventional starter in all cases of Non-Firing and Firing in all three examples. More specifically, the force pulling the starter rope of the starter according to this embodiment could be reduced as compared with the conventional starter by 30 to 40% on average, or could be reduced to ¼ of the conventional starter in an extreme case. However, with regard to the restartability and initial startability of the engine by the starter according to this embodiment, they are comparable to those of the conventional starter. With respect to the feeling of recoiling, there was no feeling of a jolt; i.e., the recoiling could be performed smoothly.

As compared with the conventional starter, the starter according to this embodiment was found to exhibit generally

some increase in the number of crankings of the internal combustion engine relative to a single recoiling by means of the starter rope, irrespective of the pulling speed of the starter rope (normal pulling speed, slow pulling speed and quick pulling speed), but also showed an increase in the initial rotational speed of the internal combustion engine, irrespective of the pulling speed of the starter rope. When the pulling speed of the starter rope of the starter of the embodiment was increased, the initial rotational speed of the internal combustion engine became 1740 r/min with seven crankings, suggesting a great effect by the inertia of the spring-attached pulley disposed in the starter.

In particular, as seen from the graphs shown FIGS. 4(*a*) and 4(*b*), it was found from the comparison between the starter according to the embodiment and the conventional starter that while it is required for the conventional starter in starting the internal combustion engine to pull the starter rope at a high speed and with a strong pull, it is possible in the case of the starter according to the embodiment to reliably start the internal combustion engine by pulling the starter rope at a slow speed and with a weak pull.

It was confirmed from the results of the aforementioned experiments that the starter of the embodiment is advantageous in the following respects over the conventional starter.

With the conventional recoil starter, since the rotational speed of the magneto rotor is required to be increased up to not less than a predetermined value which makes it possible to generate a sufficient electromotive force to ignite the engine, the starter rope is required to be pulled faster than a predetermined speed (a speed required for rotating the crank shaft). However, if the diameter for winding the starter rope is reduced, the strength for pulling the starter rope is required to be increased in order to obtain a predetermined rotational speed, whereas if the diameter for winding the starter rope is enlarged, the speed for pulling the starter rope is required to be increased in order to obtain a predetermined rotational speed, both measures being incompatible with each other. In the case of the starter of the embodiment, even if the speed for pulling the starter rope is slow, it is possible to obtain a rotational speed (a rotational speed which makes it possible to generate a sufficient electromotive force to ignite the engine) which is equal to or higher than the rotational speed of the magneto rotor which can be generated by the ordinary pulling speed of the starter rope of the conventional starter.

Further, with the conventional recoil starter, since the crank shaft (magneto rotor) is arranged to be directly rotated by pulling the starter rope, the startability of the engine is greatly influenced by the pulling speed of the starter rope. Whereas, according to the starter of this embodiment, since the spiral spring mechanism (buffering/power-accumulating device) is interposed between the starter rope and the crank shaft, the force for pulling the starter rope is not directly related to the starting of the engine, but part of the pulling force of the starter rope is accumulated in the spiral spring mechanism in the initial stage of recoiling, and this accumulated pulling force is afterward combined with the actual pulling force of the starter rope in the later stage of recoiling, thereby presenting a resultant force to start the engine. Therefore, even if the force for pulling the starter rope is weak and slow, the engine can be reliably started. The spiral spring mechanism (buffering/power-accumulating device) is capable of not only functioning to buffer and accumulate the pulling force of the starter rope, but also presenting an additional force for starting the engine by releasing the power accumulated therein.

FIGS. 5 to 9 show a power-accumulation type starter according to second embodiment of the present invention.

The power accumulation type starter **10'** of FIGS. **5** to **9** is disposed close to one end **2***a* of the crankshaft **2** of an internal combustion engine **1**, such as a small air-cooled internal combustion engine **1**. The power accumulation type starter **10'** comprises a case **11** which is adapted to be mounted on one sidewall of the internal combustion engine **1**. The case **11** is composed of two members, one of which is a cup-like case member **11***a* to a central bottom portion of which one end **12***a* of a fixing shaft **12** is fastened by means of a nut **13**.

The spiral spring mechanism **15** comprises a spiral spring **18**, which is interposed between a spiral spring box **16** and an actuating pulley **17**. The spiral spring box **16** and the actuating pulley **17** are arranged coaxially with each other and are rotatable relative to each other. Though not shown in detail in these FIGS., the outer end portion of the spiral spring **18** is attached in a well-known manner to the spiral spring box **16**, while the inner end portion of the spiral spring **18** is attached also in a well-known manner to the actuating pulley **17**, so that when the spiral spring box **16** and the actuating pulley **17** are rotated relative to each other, the rotational force thereof is accumulated in the spiral spring **18**.

The spiral spring box **16** of the spiral spring mechanism **15** is provided at the center thereof with a cylindrical portion **16***a*, and a one-way clutch **19** is interposed between the inner peripheral wall of the cylindrical portion **16***a* and the outer peripheral wall of the fixing shaft **12**, so that the spiral spring box **16** is supported by the fixing shaft **12** so as to be rotated unidirectionally about the fixing shaft **12**. The actuating pulley **17** is provided at the center thereof with a cylindrical portion **17***a* which is rotatably received on the fixing shaft **12**, and a retaining bolt **14** is screwed into the fixing shaft **12** from the other end **12***b* of the fixing shaft **12** so as to enable the actuating pulley **17** to be axially fixed and rotatably supported by the fixing shaft **12**.

The reel **20** is interposed between the cup-like case member **11***a* and the spiral spring box **16** and is rotatably supported on the outer periphery of the cylindrical portion **16** a of the spiral spring box. **16**. The reel. **20** is a rope pulley that can be manually rotated and is provided on the outer periphery thereof with an annular groove **20***a* so as to enable a rope **21** to be wound around it. In the same manner as in the case of the conventional recoiling rope type starter, one end of the rope **21** is fastened to a bottom portion of the groove **20***a*, while the other end of the rope **21** leads out of the cup-like case member **11***a* and is fastened to a rope handle **22**. Between the rope reel **20** and the cup-like case member **11***a*, there is interposed a recoil spiral spring **23**, the outer end of which is attached to the rope reel **20**, and the inner end of which is attached to a central portion of the cup-like case member **11***a*. The rope reel **20** is manually rotated, and then allowed to return to the original portion, thereby enabling the rope **21** to be automatically wound up.

Next, the interlocking mechanism between the rope reel **20** and the spiral spring box **16** will be explained with reference to FIGS. **5** and **8**. Six engaging protrusions **24** are formed on the inner periphery of the rope pulley **20**. A pivot pin **16***b* protruding toward the rope pulley **20** is integrally attached to the side wall of the spiral spring box **16** which faces the rope pulley **20**, and an interlocking claw **25** is rotatably supported on the pivot pin **16***b*. The interlocking claw **25** is resiliently engaged with one of the engaging protrusions **24** by means of a pushing spring **26** urged in the radially outward direction. Therefore, when the rope pulley **20** is rotated in one direction R (the clockwise direction in FIG. **8**), the spiral spring box **16** is also interlockingly

rotated in the same direction R. On the other hand, when the rope pulley 20 is rotated in the opposite direction L (the counter-clockwise direction in FIG. 8), the interlocking claw 25 pivots in the counter-clockwise direction about the pin so as to run idly.

The actuating pulley 17 is provided at the central portion thereof with a pair of engaging projections 31, constituting one of the members of a transmission mechanism 30 disposed to face the crank shaft 2 of the internal combustion engine 1. The pair of engaging projections 31 are joined to each other via an annular wall portion 32. On one side of the internal combustion engine 1 is disposed the interlocking pulley 35 which is fixed to the one end 2*a* of crankshaft 2. Four start-up claws 36 constituting the other member of the transmission mechanism 30 are pivotally supported by the interlocking pulley 35. Each of these start-up claws 36 is ordinarily urged in the radially inward direction by means of a spring (not shown) and hence is engaged with the engaging projections 31. However, when the internal combustion engine 1 is started, the start-up claws 36 are caused to pivot in the radially outward direction by the centrifugal force so as to be disengaged from the engaging projections 31.

As for the number of these start-up claws 36, there is no particular limitation as long as there is at least one start-up claw. The four start-up claws 36 in this embodiment are provided with a view to suitably dispersing the shock generated at the moment of actuating the start-up claws 36 as well as ensuring the actuation of the start-up claws 36.

The actuating pulley 17 is provided on the outer periphery thereof with eight ratchet teeth 37, which are arranged to be engaged with a stopper 38 for keeping the rotational force accumulating in the buffering/power-accumulating device 15 until the torque is increased to a predetermined value. The stopper 38 is attached to a reset lever 39, which is pivotally secured to the case 11. Each of the ratchet teeth 37 is provided with an engaging face 37*a* which is directed toward the center of the actuating pulley 17 and with a slant face 37*b*. The engaging face 37*a* is arranged to be engaged with the stopper 38 so as to prevent the actuating pulley 17 from rotating.

The reset lever 39 is pivotally secured to the case 11 and permitted to move between the stop position S and the free position F by means of an over dead center type instantaneous switching mechanism 40. The instantaneous switching mechanism 40 is constituted by a compression coil spring 43 which is interposed between an anchoring portion 42 of an anchoring member 41 which extends from the cup-like case member 11*a* and the reset lever 39. Specifically, the anchoring member 41 is provided with a chamfered hole or a concave hole functioning as the anchoring portion 42. An adjuster pin 45 is screw-engaged with a shaft member 44 which is fixed to the reset lever 39, and an upper portion of the adjuster pin 45 is constituted by an engaging portion 46 which is formed into a chamfered hole or a concave face. Between the anchoring portion 42 and the engaging portion 46, there is disposed the compression coil spring 43 in a compressed state. A pin 47 having a semispherical head is inserted into both ends of the compression coil spring 43. As shown in FIG. 9, the anchoring portion 42 of the anchoring member 41 is positioned such that it is slightly offset toward the stop position S from the center of the pivotable range of the reset lever 39.

Accordingly, when the reset lever 39 is located at the stop position S or the free position F, the compression coil spring 43 is caused to lengthen slightly, whereas when the reset lever 39 is located at the center of the pivotable range of the reset lever 39, the compression coil spring 43 is caused to shorten slightly, thereby permitting the reset lever 39 to pass through the intermediate range and hence to instantaneously move to the stop position S or the free position F. The lower end portion 39*a* of the reset lever 39 protrudes from the case 11, thereby allowing the reset lever 39 to be manipulated by way of the lower end portion 39*a* in switching it to the stop position S or the free position F. The force of the compression coil spring 43 can be adjusted by suitably rotating the adjuster pin 45.

When the reset lever 39 is moved to the stop position S, since the compression coil spring 43 acts on the anchoring portion 42 and the engaging portion 46 of the reset lever 39, the stopper 38 is subjected, as a component force of the compression coil spring 43, to a pushing force f1 (see FIG. 6) in the direction toward the actuating pulley 17. Due to the pushing force f1, the actuating pulley 17 is prevented from being rotated in spite of the accumulated power in the spiral spring 18. Therefore, when the rotational force f2 of the actuating pulley 17 is increased, due to an increasing accumulation of force in the spiral spring 18 by the repetition of pulling the starter rope 21, over the pushing force f1 of the stopper 38, the reset lever 39 is caused to gradually pivot toward the opposite side. Thereafter, when the reset lever 39 is further moved to pass through the aforementioned intermediate range, the reset lever 39 is caused to instantaneously move to the free position F, thereby automatically releasing the stopper 38 and at the same time, allowing the actuating pulley 17 to rotate at a speed which corresponds to the magnitude of accumulation of force in the spiral spring 18.

The reset lever 39 is positioned on the same side of the starter 10' as the rope handle 22 relative to the center of the power accumulation type starter 10' (the right side in FIGS. 6 and 7), so that when an operator carries on his back a small working machine provided with the internal combustion engine 1, the reset lever 39 and the rope handle 22 will both be located on the same side of the machine, thereby enabling the operator to easily manipulate the rope handle 22 and to start the engine 1 with only one hand.

Next, the operation of the power-accumulation type starter 10' constructed according to the second embodiment will be explained. When the internal combustion engine 1 is to be started, the rope handle 22 is manually pulled so as to rotate the rope pulley 20. The rotation of the rope pulley 20 is transmitted to the spiral spring box 16 through the interlocking claw 25 which is resiliently engaged with one of the engaging protrusions 24, thereby allowing the spiral spring box 16 to be rotated synchronously with the rotation of the rope pulley 20. When the pulling force of the rope handle 22 is released, the rope pulley 20 is allowed to reversibly rotate and return to the original position due to the accumulated power (restoring force) of the recoil spiral spring 23. However, the spiral spring box 16 is prevented from rotating reversibly due to the one-way clutch 19, thereby permitting the spiral spring 18 to store a rotational force.

In this case, even if the speed of pulling the rope handle 22 is slow, or even if the pulling distance is short, a rotational force corresponding to such a degree of pulling is stored in the spiral spring mechanism 15, so that if the pulling distance is relatively short, it is simply required to correspondingly increase the number of pulls of the starter rope 21 so as to accumulate the rotational force until a predetermined value of torque is reached. When the rotational force accumulated as a result of the repetition of pulls of the rope handle 22 reaches a predetermined value of torque, the pushing force f2 pushing the stopper 38 by the ratchet tooth

37 of the actuating pulley 17 is increased so as to cause the reset lever 39 to be gradually pivoted in the counter-clockwise direction. As a result, the compression coil spring 43 is compressed.

When the pushing force f2 is further increased, the reset lever 39 is further pivoted, so that as soon as the engaging portion 46 of the reset lever 39 passes through a point on a line extended over the anchoring portion 42, the reset lever 39 is instantaneously switched to the free position F due to the pushing force of the compression coil spring 43, whereby the compression coil spring 43 is caused to lengthen slightly from the compressed state thereof. As explained above, by means of the instantaneous switching mechanism 40, the reset lever 39 is automatically and instantaneously switched to the free position F from the stop position S.

When the reset lever 39 is switched to the free position F, the rotational force accumulated in the spiral spring mechanism 15 is released all at once, thereby causing the interlocking pulley 35 to be rotated by means of the four start-up claws 36, which are engaged with the engaging projections 31. As a result, the crank shaft 2 is rotated with a large torque, thereby making it possible to easily start the internal combustion engine 1. When the internal combustion engine 1 is started, the four start-up claws 36 are caused to pivot in the radially outward direction by the centrifugal force so as to be disengaged from the engaging projections 31, thereby allowing the internal combustion engine 1 to continuously rotate with the actuating pulley 17 being dissociated from the interlocking pulley 35. Since the rotational force which has been retained at a predetermined value of torque can be transmitted all at once to the interlocking pulley 35 from the actuating pulley 17, the internal combustion engine 1 can be easily and reliably started.

When the reset lever 39 is manually switched to the free position F, the reset lever 39 is enabled to be instantaneously switched from the stop position S to the free position F by means of the instantaneous switching mechanism 40. When the rope handle 22 is pulled under this condition, the rotation of the rope pulley 20 is transmitted via the interlocking claw 25 to the spiral spring box 16 to thereby wind up the spiral spring 18, while the spiral spring box 16 is prevented from being reversibly rotated by means of the one-way clutch 19. Although the rotational force by the power accumulated in the spiral spring 18 is presented to the actuating pulley 17 to which the inner end of the spiral spring 18 is attached, since the start-up claws 36 of the interlocking pulley 35 are engaged with the engaging projections 31 of the actuating pulley 17, the interlocking pulley 35 is prevented from rotating at the position where the load is large at the compression stroke of the internal combustion engine 1, thereby rendering the starter 10' in a power-accumulating state.

When the rope handle 22 is further pulled, the rotation of the rope pulley 20 is transmitted likewise via the interlocking claw 25 to the spiral spring box 16 to thereby wind up the spiral spring 18. As a result, the amount of accumulated rotational power in the spiral spring 18 becomes larger gradually, and when the value of torque exceeds the load being imposed by the engine 1, the rotational force of the spiral spring 18 is transmitted, via the engaging projections 31 of the transmission mechanism 30 and the start-up claws 36, to the interlocking pulley 35, thereby enabling the crank shaft 2 to rotate and hence enabling the internal combustion engine 1 to be started.

When the internal combustion engine is started directly by means of the starter rope as in the case of the conventional recoil starter, the load from the internal combustion engine side is rendered to be directly received by the rope handle. As a result, the load is directly transmitted to the operator's hand. Whereas, when the pulling force of the rope handle 22 is transmitted via the spiral spring 18 to the actuating pulley 17 and then, transmitted via the transmitting mechanism 30 to the interlocking pulley 35 as described above, the load from the internal combustion engine side can be alleviated by means of the spiral spring 18. In this case, the spiral spring 18 functions also as a buffering device to the load.

While the foregoing embodiments of the present invention have been explained, it will be understood that the construction of the device can be varied without departing from the spirit and the scope of the invention.

For example, although a spiral spring mechanism is employed as a buffering/power-accumulating device in the above first embodiment, the buffering/power-accumulating device is not confined to such a spiral spring mechanism, but may be any kind of device as long as it is capable of buffering and storing part of the driving side force in a first part of recoiling and at the same time, capable of outputting to the driven side the stored power in the latter part together with the pulling force of the driving side to be supplied in the latter part.

Further, although a spiral spring box securing the outer periphery of the spiral spring is manually rotated so as to rotate the crank shaft by means of an actuating pulley securing the inner periphery of the spiral spring in the above first embodiment, the mechanism may be reversed, i.e., a pulley securing the inner periphery of the spiral spring is manually rotated, and the crank shaft is rotated by means of a spiral spring box securing the outer periphery of the spiral spring.

Further, although a one-way clutch is exemplified as a device for effecting the unidirectional rotation, other means such as a ratchet mechanism may be employed. Although a recoil type rope pulley which can be rotated by pulling a rope is exemplified as a manual reel, it may be constructed to manually rotate a reel by making use of a crank, etc. Further, the transmission mechanism may be constructed to utilize a ratchet mechanism.

In the second embodiment, although a compression coil spring is exemplified as a spring member for the instantaneous switching mechanism, a tension spring may be employed so as to enable the reset lever to instantaneously pass through the intermediate point. Although a recoil type rope pulley is exemplified as a manual reel in the second embodiment, it may be constructed to manually rotate a reel by making use of a crank, etc.

As explained above, it is possible according to the present invention to minimize fluctuations in the pulling force of a starter rope handle so as to make it possible to perform a smooth pulling operation. Therefore, it is now possible, even for a person having weak physical strength, to easily start the engine. Further, since an internal combustion engine can be started always with an optimum timing, the startability of the engine can be improved.

It is possible, according to the power-accumulation type starter of the present invention, to instantaneously release an accumulated power by means of a reset lever, and hence to transmit all at once the rotational force accumulated in the spiral spring accumulation mechanism to the crank shaft, thereby enabling the engine to be reliably started. Additionally, the starter can be simplified in construction, made small in size, and lightened in weight. In a case where the accumulation of power is not necessitated, the starter can

be employed in such a manner that the reset lever is shifted to the free position in advance and then the rope handle is pulled, thereby buffering a load from the internal combustion engine side. Furthermore, since a decompressor is not required to be employed in the present invention, the environmental problem associated with use of a decompressor can be avoided.

What is claimed is:

1. A power accumulation-type starter for an internal combustion engine having a crankshaft rotatable about a first axis, comprising:

an interlocking pulley drivably coupled to the crankshaft for rotating the crankshaft in a starting direction about the first axis;

an actuating pulley drivably coupled to the interlocking pulley for rotating the interlocking pulley in the starting direction about a second axis;

a centrifugal clutch operatively interposed between the actuating pulley and the interlocking pulley for disengaging the driving coupling therebetween upon start-up of the internal combustion engine;

a spiral spring box rotatable about the second axis;

a spiral spring encircling the second axis and connected at one end portion to the spiral spring box and at the other end portion to the actuating pulley;

a unidirectional clutch interposed between the spiral spring box and the second axis for permitting rotation of the spiral spring box, and thereby winding of the spiral spring to accumulate energy therein at least sufficient to overcome the rotational resistance exerted by the internal combustion engine on the crank shaft, in one rotational direction about the second axis but preventing rotation of the spiral spring box in the reverse rotational direction about the second axis; and

a manually-actuated recoil pulley drivably coupled directly,to the spiral spring box for unidirectionally rotating the spiral spring box in said one rotational direction to cause the spiral spring to be wound about the second axis;

whereby manual actuation of the recoil pulley for one or more times causes energy at least sufficient to overcome the rotational resistance of the internal combustion engine to be stored in the spiral spring.

2. A starter according to claim 1, wherein said one end portion of the spiral spring is the radially outer end portion and said other end portion is the radially inner end portion.

3. A starter according to claim 1, further comprising:

a reset mechanism having a first state of operation, in which the mechanism prevents rotation of the interlocking pulley in the starting direction, and a second state of operation, in which the reset mechanism does not prevent said rotation of the interlocking pulley; and

the reset mechanism is selectively switchable from said first state of operation to said second state of operation.

4. A starter according to claim 3, wherein the reset mechanism automatically switches from the first state of operation to the second state of operation in response to the spring force stored in the spiral spring reaching a level at least as high as that required to overcome the rotational resistance of the internal combustion engine.

5. A starter according to claim 4, wherein the level of spring force at which the reset mechanism automatically switches from the first to the second state of operation is in excess of the level required to overcome the rotational resistance of the internal combustion engine.

6. A starter according to claim 3, wherein the reset mechanism comprises a reset lever that is movable between stop and free positions, movement of the lever into the stop position causing the reset mechanism to be placed in the first state of operation and movement of the lever into the free position causing the reset mechanism to be placed in the second state of operation.

7. The starter of claim 6, wherein the reset lever is movable from said stop position to said free position by an instantaneous switching mechanism.

8. A starter according to claim 7, wherein the instantaneous switching mechanism includes a spring member interposed between an anchoring portion and the reset lever.

9. A starter according to claim 6, wherein the reset lever is manually movable from the stop position to the free position.

10. A starter according to claim 1, wherein:

the recoil pulley is coaxially mounted with the spiral spring box for rotation about the second axis; and

the recoil pulley includes a rope-winding groove on its outer periphery for receipt of a manually-operated starter rope wound thereon.

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(54) **RECOIL STARTER**

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(73) Assignee: **Kioritz Corporation**, Tokyo (JP)

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(51) **Int. Cl.**[7] **F02N 1/00**
(52) **U.S. Cl.** **123/185.3**
(58) **Field of Search** ..... 123/185.3, 185.2, 123/185.4, 185.14; 185/40 R, 41 R, 41 A, 41 C

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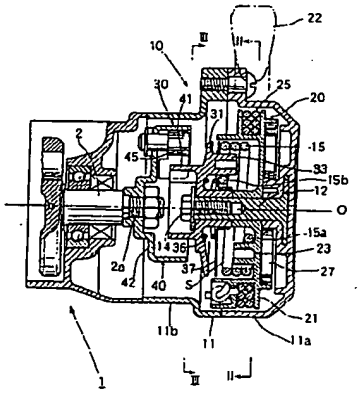
(57) **ABSTRACT**

A recoil starter includes a rotary driving member that is adapted to be rotated by pulling a recoil rope and an interlocking rotary member that is adapted to be rotated independently of the rotary driving member. A buffering spring is coupled between the rotary driving member and the interlocking rotary member. The buffering spring, which may be a torsion coil spring or a spiral spring, applies a rotational bias between the rotary driving member and the interlocking rotary member and is adapted to transmit the rotation of the rotary driving member to the interlocking rotary member.

10 Claims, 3 Drawing Sheets



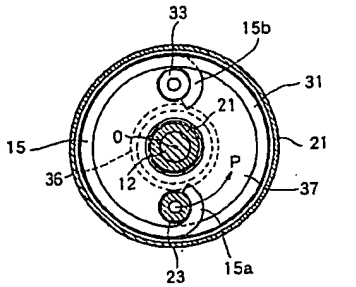


Fig.1

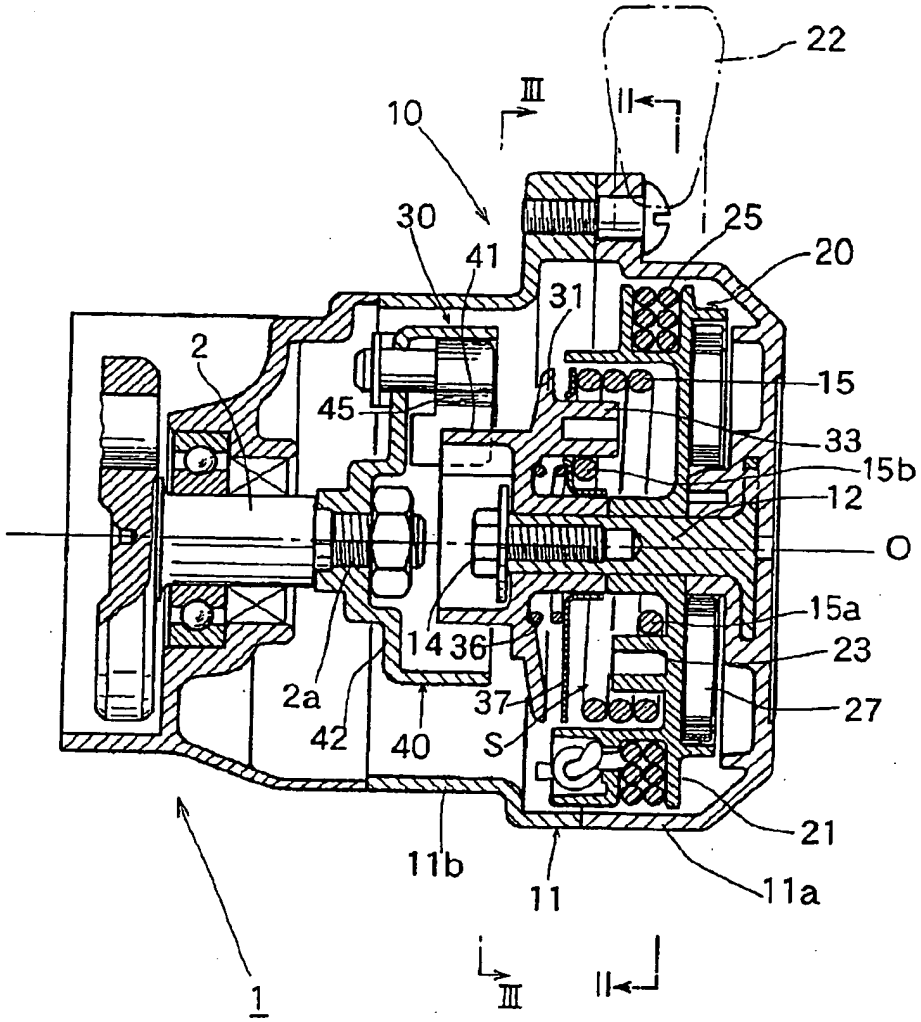

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Fig.2

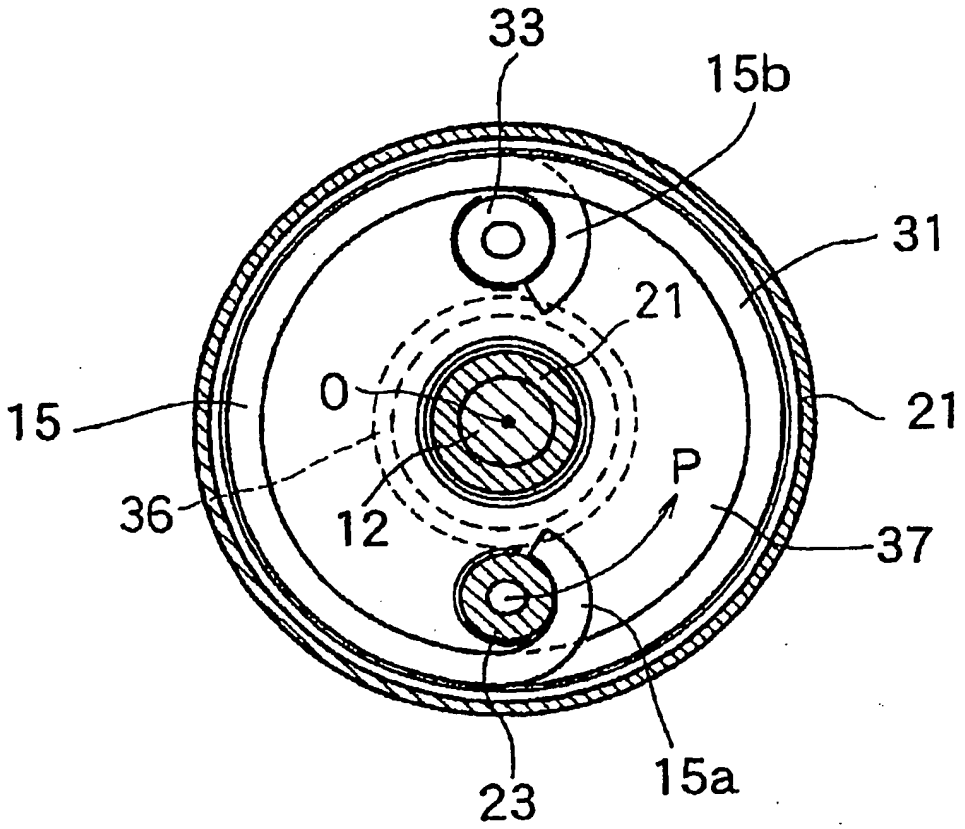
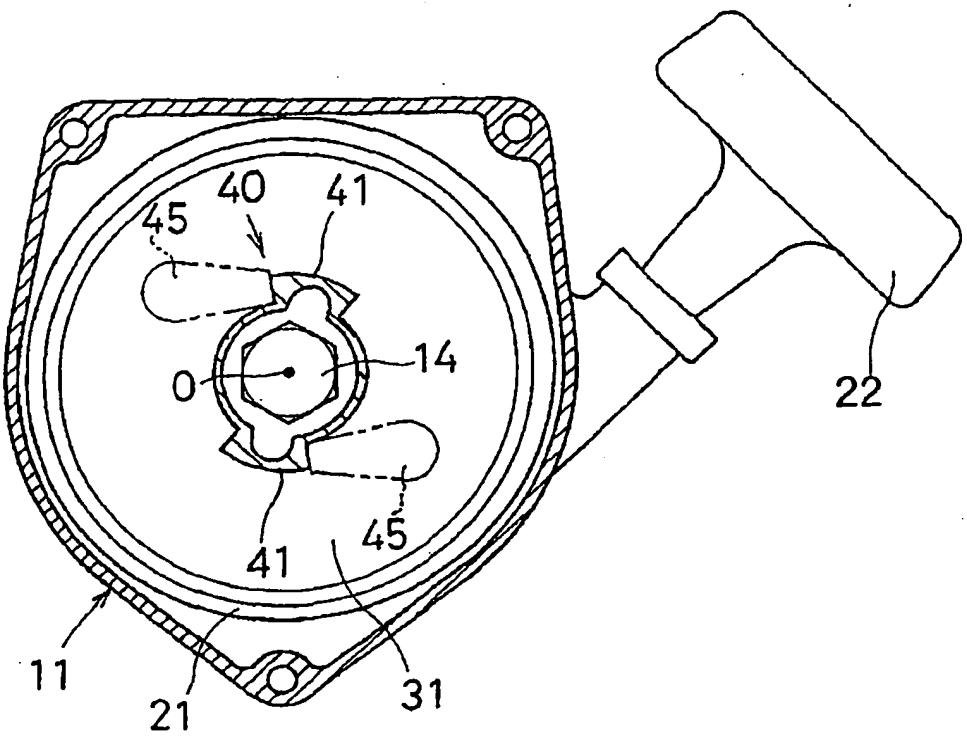


Fig.3



RECOIL STARTER

BACKGROUND OF THE INVENTION

The present invention relates to a recoil starter for an internal combustion engine and, in particular, to a recoil starter that allows fluctuations in the pulling force of a recoil rope to be reduced.

The recoil starters conventionally used for small internal combustion engines usually have a rope reel that is rotated by pulling a recoil rope that is wound onto the rope reel and fitted with a handle. The resulting rotation of the rope reel is transmitted by, for example, a centrifugal ratchet mechanism, to the crankshaft of the internal combustion engine, thereby "start-up" the internal combustion engine.

In the case of an internal combustion engine which is provided with such a recoil starter, a decompressor is frequently attached to the internal combustion engine in order to minimize the pulling force (rope pulling force) of the recoil rope that is required for starting the internal combustion engine.

It is required, in the case of the conventional recoil starter described above, to strongly and quickly pull the recoil rope in order to start up the internal combustion engine. Furthermore, although it is possible to rotate the crankshaft by pulling the recoil rope, it has been impossible to obtain a smooth rope-pulling operation due to large fluctuations of the load imposed on the recoil rope by the engine, i.e., the fluctuations originating from the compression stroke or sliding resistance of the piston relative to the rotation of the crankshaft, thereby making it difficult for a person having a weak physical strength to start the internal combustion engine.

When a decompressor is attached to the internal combustion engine, it is possible to reduce the rope pulling force required for actuating the internal combustion engine. However, the provision of a decompressor leads not only to an increased complication of the structure of the device, and hence to an increase in manufacturing cost, but also to the release of unburned air-fuel mixture into the atmosphere and contamination of the environment.

BRIEF SUMMARY OF THE INVENTION

The present invention has been made to overcome the aforementioned problems. It is, in particular, an object of the present invention to provide a recoil starter that permits fluctuations of the rope pulling force to be reduced, thereby making it possible to perform a smooth rope-pulling operation and also to easily actuate the internal combustion engine, even by a person having a weak physical strength.

With a view to attaining the aforementioned object, there is provided, in accordance with the present invention, a recoil starter having a rotary driving member that is adapted to be rotated by pulling a recoil rope and an interlocking rotary member that is adapted to be rotated independently of the rotary driving member. A buffering spring is coupled between the rotary driving member and the interlocking rotary member. The buffering spring, which may be a torsion coil spring or a spiral spring, applies a rotational bias between the rotary driving member and the interlocking rotary member and is adapted to transmit the rotation of the rotary driving member to the interlocking rotary member.

In a preferred embodiment of the recoil starter according to the present invention, the rotary driving member and the interlocking rotary member are disposed on a common rotational axis.

The rotary driving member is, preferably, a rope reel which is adapted to have the recoil rope wound thereon. The rope reel may have an annular cavity, in which case the buffering member is disposed inside the annular cavity of the rope reel.

In preferred embodiments, the interlocking rotary member is a power transmission pulley to which the rotation of the rotary driving member is transmitted through the buffering member. The recoil starter further includes a centrifugal ratchet mechanism coupled to the power transmission pulley and adapted to be coupled to a crankshaft of an internal combustion engine for transmitting the rotation of the power transmission pulley to the crankshaft of the internal combustion engine.

In preferred embodiments of the recoil starter of the present invention as constructed above, when the recoil rope (recoil handle) is pulled, the rope reel of the rotary driving member is caused to rotate, and the rotation of the rotary driving member is transmitted via the buffering member to the power transmission pulley of the interlocking rotary member. The rotation of the power transmission pulley is then transmitted via the centrifugal ratchet mechanism to the crankshaft of the internal combustion engine, thereby starting the internal combustion engine through the rotation of the crankshaft.

Since the buffering member is elastically compressed in the rotational direction of the rope reel when the recoil rope is pulled, the buffering member functions not only as a power transmitting member for transmitting the rotation of the rope reel to the power transmission pulley but also as a power reservoir and a cushion or a shock absorber, thereby making it possible to minimize the fluctuations of the rope pulling force as much as possible.

Therefore, it is now possible with the recoil starter of the present invention to attain a smoother rope-pulling operation as compared with the conventional recoil starter, thereby making it possible to easily actuate the internal combustion engine, even for a person having a weak physical strength.

Furthermore, since the recoil starter according to the present invention can be constructed by simply disposing a buffering member such as a torsion coil spring in a cavity of the rope reel of a conventional recoil starter, the increases in total weight and in the manufacturing cost can be minimized. It may also not be necessary to provide a decompressor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view illustrating one embodiment of the recoil starter according to the present invention;

FIG. 2 is a cross-sectional view taken along the line II—II in FIG. 1; and

FIG. 3 is a cross-sectional view taken along the line III—III in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

The recoil starter 10 shown in FIG. 1 is adapted to be disposed close to one end portion 2*a* of the crankshaft 2 of an internal combustion engine 1, such as a small air-cooled two-stroke gasoline engine, and comprises a case 11 of two-piece structure, which is cylindrical as a whole in configuration so as to enable it to be attached to one side of the internal combustion engine 1. A rotary driving member 20, which is adapted to be rotated by pulling a recoil rope 25 by means of a handle 22, is disposed inside the outer case

11*a* of the case 11 which is located remote from the internal combustion engine 1. An interlocking rotary member 30, which is adapted to be rotated independently of the rotary driving member 20, is disposed inside an inner case 11*b*.

More specifically, a supporting axle 12 projects distally toward the inner case 11*b* from the central portion of the outer case 11*a*. A rope reel 21 having the recoil rope 25 wound around it is rotatably fitted on a proximal portion of the supporting axle 12. A power transmitting pulley 31 is rotatably fitted on a distal portion of the supporting axle 12 for rotation independently of the rotation of the rope reel 21. A fastening screw 14 is threaded into the distal end of the supporting axle 12.

The axis of the supporting axle 12 as well as the rotational axes of the rope reel 21 and the power transmitting pulley 31 are coaxially aligned with the rotational axis O of the crankshaft 2 of the internal combustion engine 1. A torsion coil spring 15 functioning as a buffering member is disposed coaxially with the rotational axis O in a cavity S of the rope reel 21.

As shown in FIG. 2, the torsion coil spring 15 is constructed such that a hook portion 15*a* at one end of the torsion coil spring 15 and which is located close to the outer case 11*a* is hooked to a first locking portion 23 that projects from the rope reel 21. A hook portion 15*b* at the other end of the torsion coil spring 15 and which is located close to the inner case 11*b* is hooked to a second locking portion 33 that projects from the power transmitting pulley 31. A compression coil spring 36 that is engaged in slight compression between the power transmitting pulley 31 and a spring disk shoe 37 biases the torsion coil spring 15 toward the rope reel 21 along the rotational axis O.

A recoil spiral spring 27 is arranged between the outer case 11*a* and the rope reel 21 in such a manner that the outer end thereof is secured to the rope reel 21 and the inner end thereof is secured to a central portion of the outer case 11*a* in the same manner as that of the conventional recoil starter. Whenever the rope reel 21 is released after having been rotated to a desired extent by pulling out of the recoil rope 25, the recoil rope 25 is automatically rewound onto the rope reel 21 by the restoring force of the recoil spiral spring 27.

The interlocking rotary member 30 consists of the power transmitting pulley 31 and a centrifugal ratchet mechanism 40. As shown in FIG. 3, the centrifugal ratchet mechanism 40 comprises a pair of power transmitting protrusions 41, each projecting from the surface of the power transmitting pulley 31 which faces the internal combustion engine 1, and a clutch claw case 42, which is fixed to the end portion 2*a* of the crankshaft 2. The clutch claw case 42 is provided with a pair (for example) of starting claws 45, each pivotally supported by the clutch claw case 42. The starting claws 45 are normally urged inwardly (toward the rotational axis O) by means of a spring (not shown) so as to engage with the aforementioned pair of power transmitting protrusions 41. However, when the internal combustion engine 1 is started, the starting claws 45 are caused to rotate or pivot outward in the radial direction due to the centrifugal force produced by the rotation of the clutch claw case 42 as it is driven by the crankshaft 2, thereby permitting the starting claws 45 to disengage from the power transmitting protrusions 41.

In the operation of the recoil starter 10 of the embodiment, when the recoil rope 25 is pulled, the rope reel 21 of the rotary driving member 20 is caused to rotate in the direction P in FIG. 2. The rotation of the rotary driving member 20 is transmitted via the torsion coil spring 15 to the power transmission pulley 31 of the interlocking rotary member 30. The rotation of the power transmission pulley 31 is then transmitted via the centrifugal ratchet mechanism 40 (the power transmitting protrusions 41 and the starting claws 45) to the crankshaft 2 of the internal combustion engine 1, thereby starting up the internal combustion engine 1 through the rotation of the crankshaft 2.

Since the torsion coil spring 15 is elastically compressed in the rotational direction of the rope reel 21 (in the direction P in FIG. 2) when the rope reel 21 is rotated by pulling out the recoil rope 25, the torsion coil spring 15 functions not only as a power transmitting member for transmitting the rotation of the rope reel 21 to the power transmission pulley 31, but also as a power reservoir and a cushion or a shock absorber, thereby making it possible to minimize, as much as possible, the fluctuations in pulling force of the recoil rope 25.

Accordingly, the recoil starter 10 of the embodiment provides a smoother rope-pulling operation as compared with the conventional recoil starter, thereby making it possible for even a weak person to easily start the internal combustion engine.

Furthermore, since the recoil starter according to the present invention can be constructed by simply disposing a buffering member, such as a torsion coil spring or a spiral spring, in a cavity of the rope reel of a conventional recoil starter, the increases in total weight and in the manufacturing cost can be minimized, Also, it may not be necessary to provide the internal combustion engine with a decompressor.

The embodiment of the present invention described above and shown in the drawings is intended to be exemplary. Numerous variations and modifications of the exemplary embodiment can be made by those skilled in the art without departing from the spirit and scope of the invention as set forth in the accompanying claims.

What is claimed is:

1. A recoil starter, comprising

a rotary driving member that is adapted to be rotated by pulling a recoil rope,

an interlocking rotary member that is adapted to be rotated independently of the rotary driving member,

a buffering spring coupled directly between the rotary driving member and the interlocking rotary member, applying a rotational bias between the rotary driving member and the interlocking rotary member, an adapted to transmit the rotation of the rotary driving member to the interlocking rotary member, and

a hook portion at one end of the buffering spring and located within the buffering spring.

2. The recoil starter according to claim 1, wherein the rotary driving member and the interlocking rotary member are disposed on a common rotational axis.

3. The recoil starter according to claim 1, wherein the buffering member is a torsion coil spring or a spiral spring.

4. The recoil starter according to claim 2, wherein the buffering member is a torsion coil spring or a spiral spring.

5. The recoil starter according to any one of claims 1 to 4, wherein the rotary driving member is a rope reel which is adapted to have the recoil rope wound thereon, the rope reel has an annular cavity, and the buffering member is received in the annular cavity of the rope reel.

6. The recoil starter according to any one of claims 1 to 4, wherein the interlocking rotary member includes a power transmission pulley to which the rotation of the rotary driving member is transmitted through the buffering member and a centrifugal ratchet mechanism coupled to the power transmission pulley and adapted to be coupled to a crankshaft of an internal combustion engine for transmitting the

rotation of the power transmission pulley to the crankshaft of the internal combustion engine.

7. A recoil starter, comprising

a rotary driving member that is adapted to be rotated by pulling a recoil rope,

an interlocking rotary member that is adapted to be rotated independently of the rotary driving member, and

a buffering spring coupled between the rotary driving member and the interlocking rotary member, applying a rotational bias between the rotary driving member and the interlocking rotary member, and adapted to transmit the rotation of the rotary driving member to the interlocking rotary member,

wherein the interlocking rotary member includes a power transmission pulley to which the rotation of the rotary driving member is transmitted through the buffering member and a centrifugal ratchet mechanism coupled to the power transmission pulley and adapted to be coupled to a crankshaft of an internal combustion engine for transmitting the rotation of the power transmission pulley to the crankshaft of the internal combustion engine.

8. The recoil starter according to claim 7, wherein the rotary driving member and the interlocking rotary member are disposed on a common rotational axis.

9. The recoil starter according to claim 7, wherein the buffering member is a torsion coil spring or a spiral spring.

10. The recoil starter according to claim 8, wherein the buffering member is a torsion coil spring or a spiral spring.

* * * * *

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(54) RECOIL STARTER

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Jul. 24, 2002 (JP) 2002-215455

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(52) U.S. Cl. ..... 74/8; 74/7 C

(57) ABSTRACT

A recoil starter enabling a power-driven device to be coupled to a crankshaft of an engine in a state where the recoil starter is mounted to the crankshaft on the same side of the engine as the crankshaft is disposed on. A starter housing is provided on an inside thereof with a reel support shaft which projects coaxially with the crankshaft. A rope reel having a recoil rope wound thereon and a cam, which transmits rotation via centrifugal ratchets to the crankshaft, are rotatably mounted on the reel support shaft while they are rotatingly coupled to each other via a damper spring. An opening is formed in the reel support shaft so as to extend from a distal end thereof near the crankshaft to the outside of the starter housing. A drive shaft of the device is coupled to the crankshaft inside the opening.

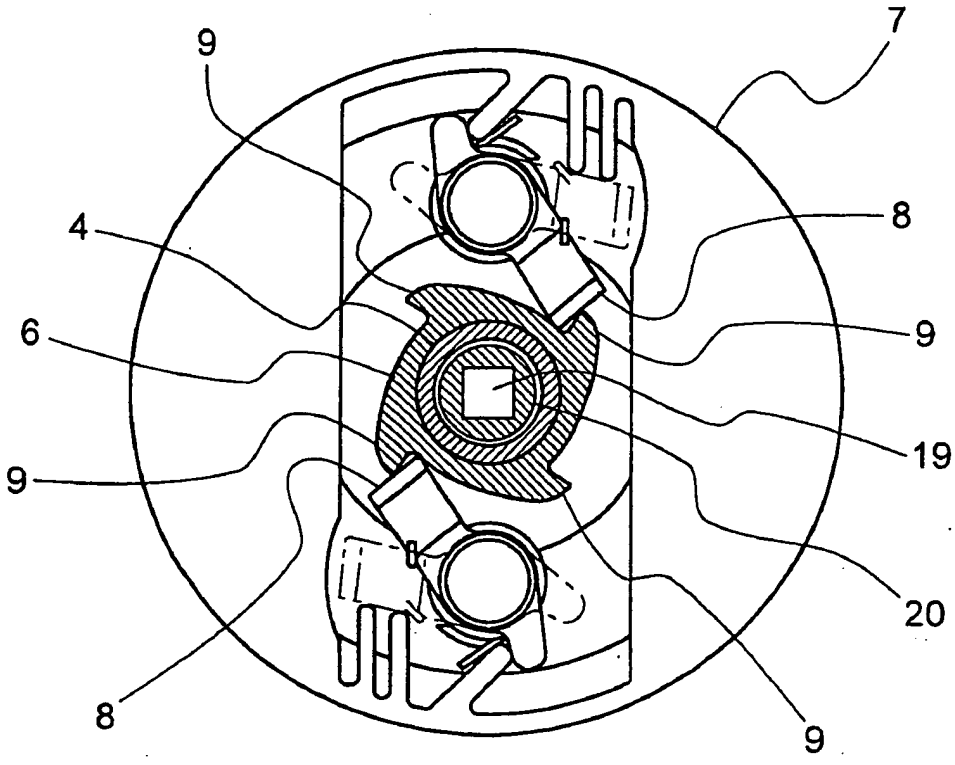
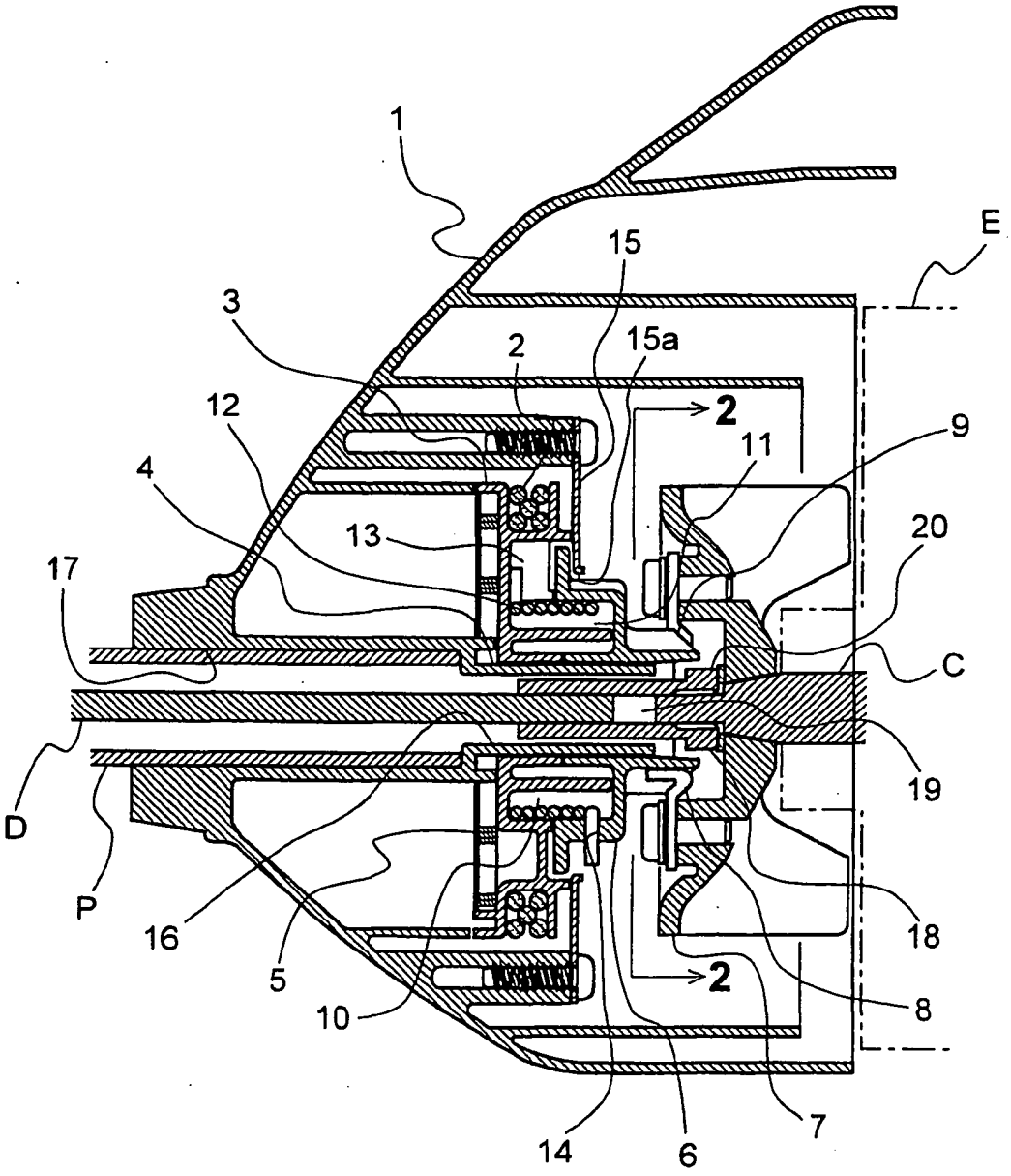


FIG. 1



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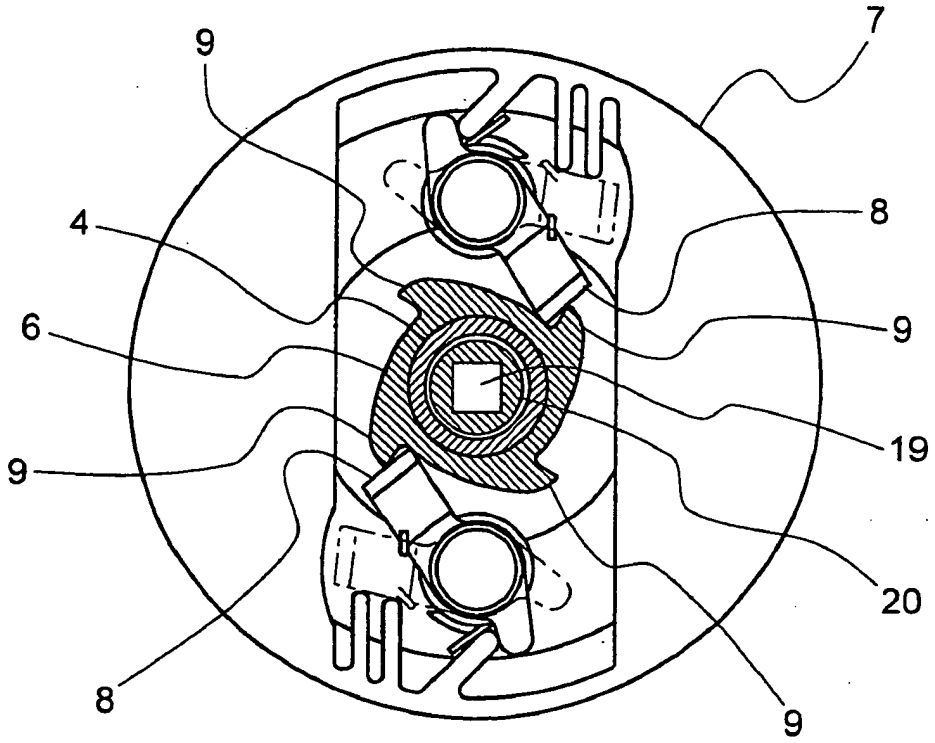

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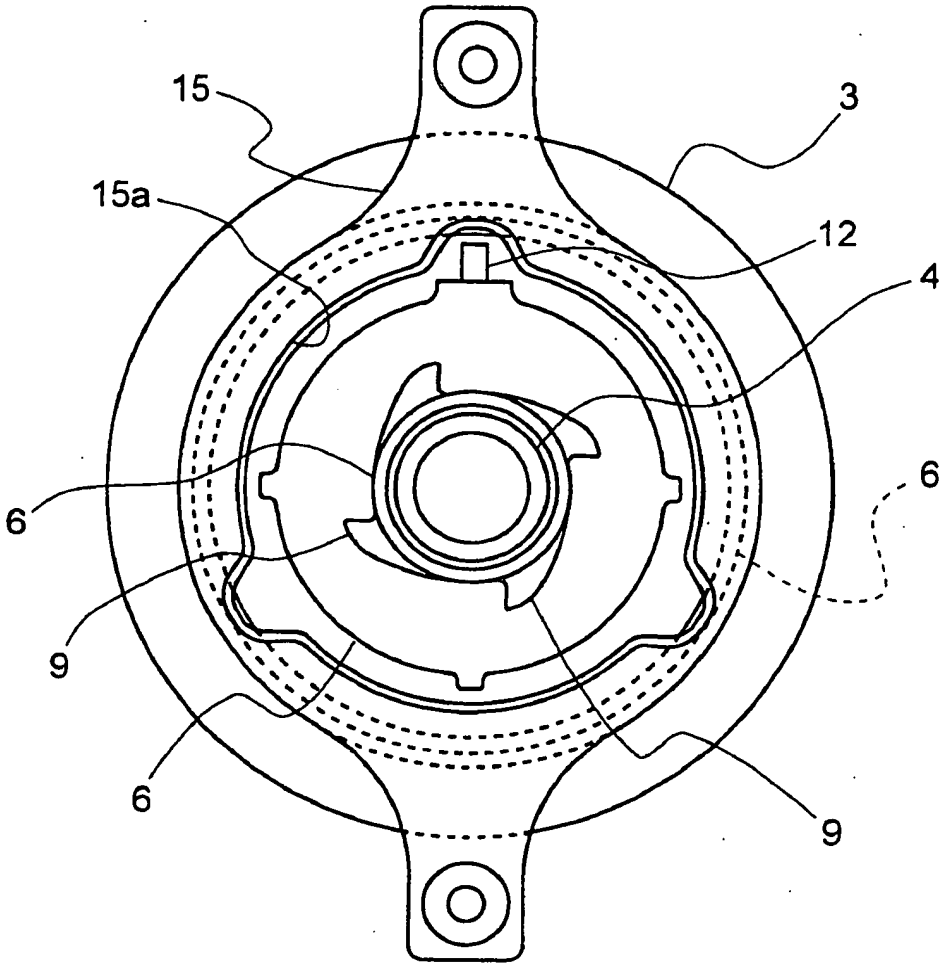

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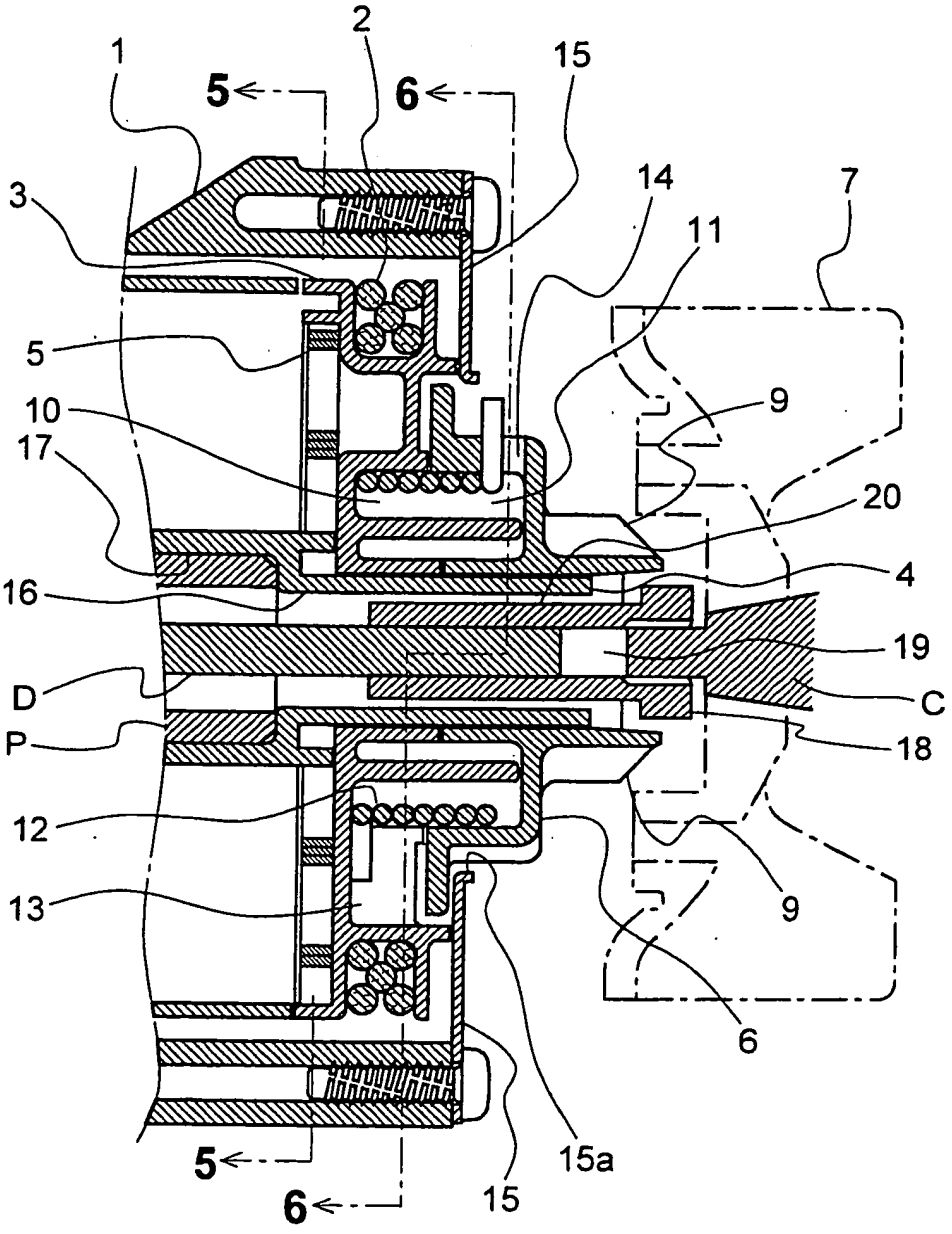

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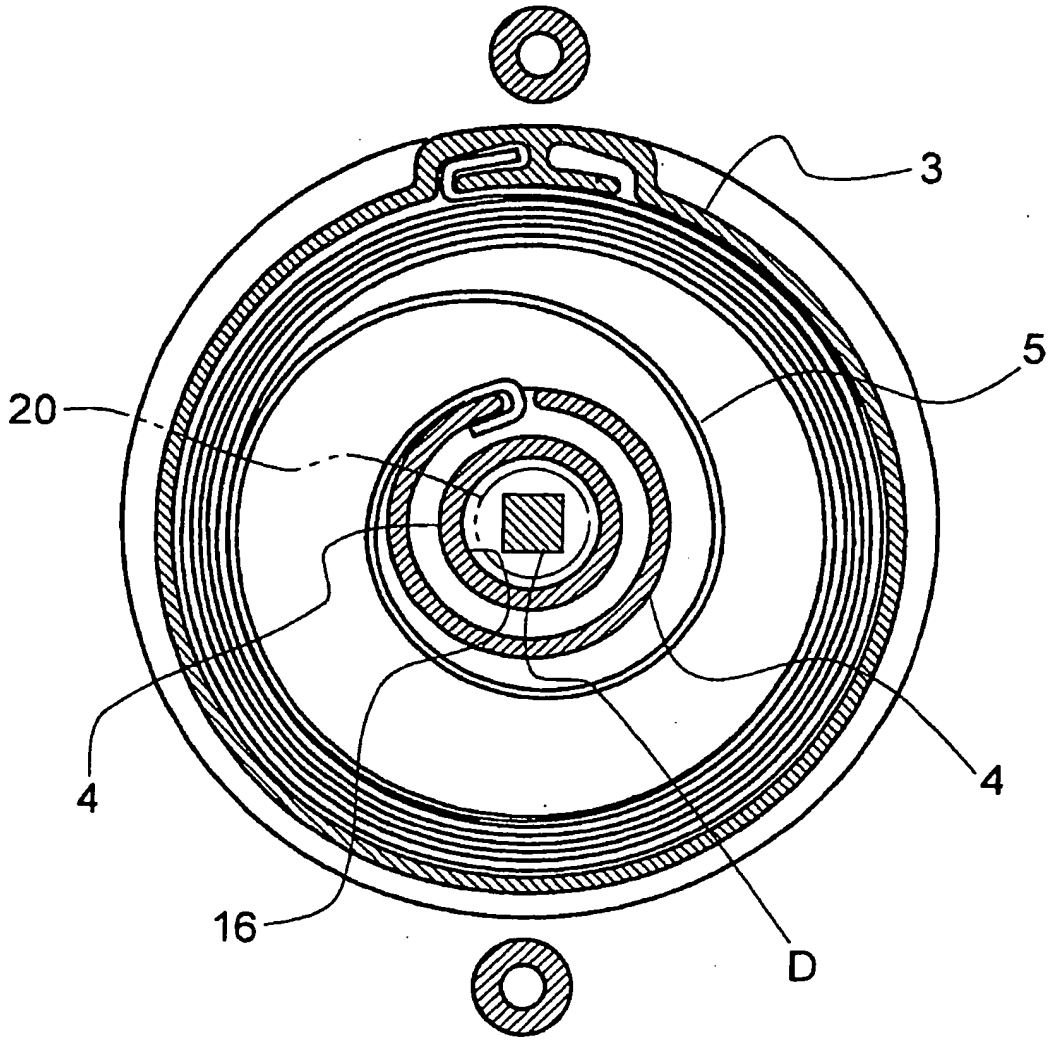
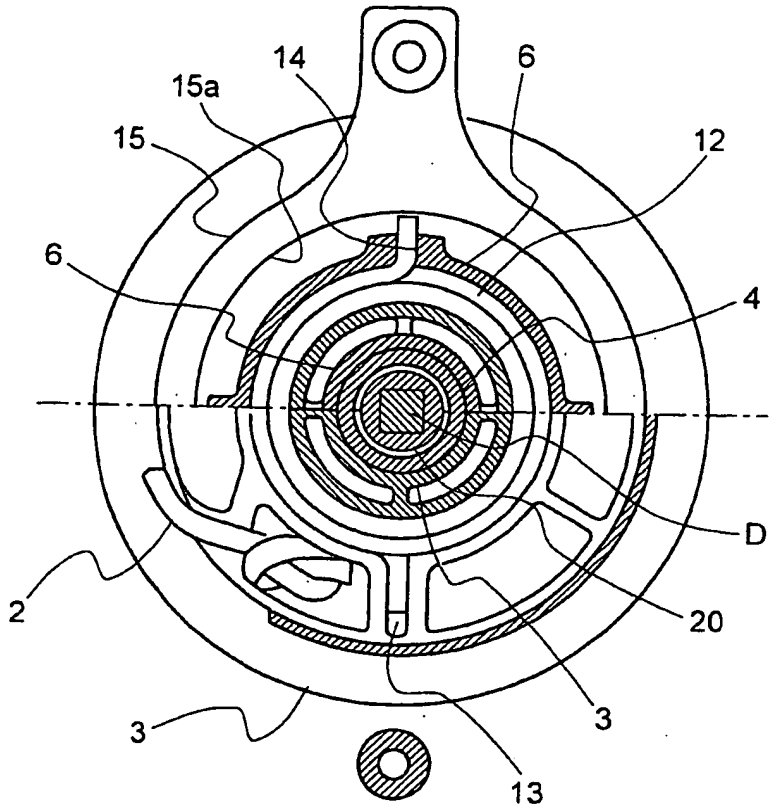


FIG. 6



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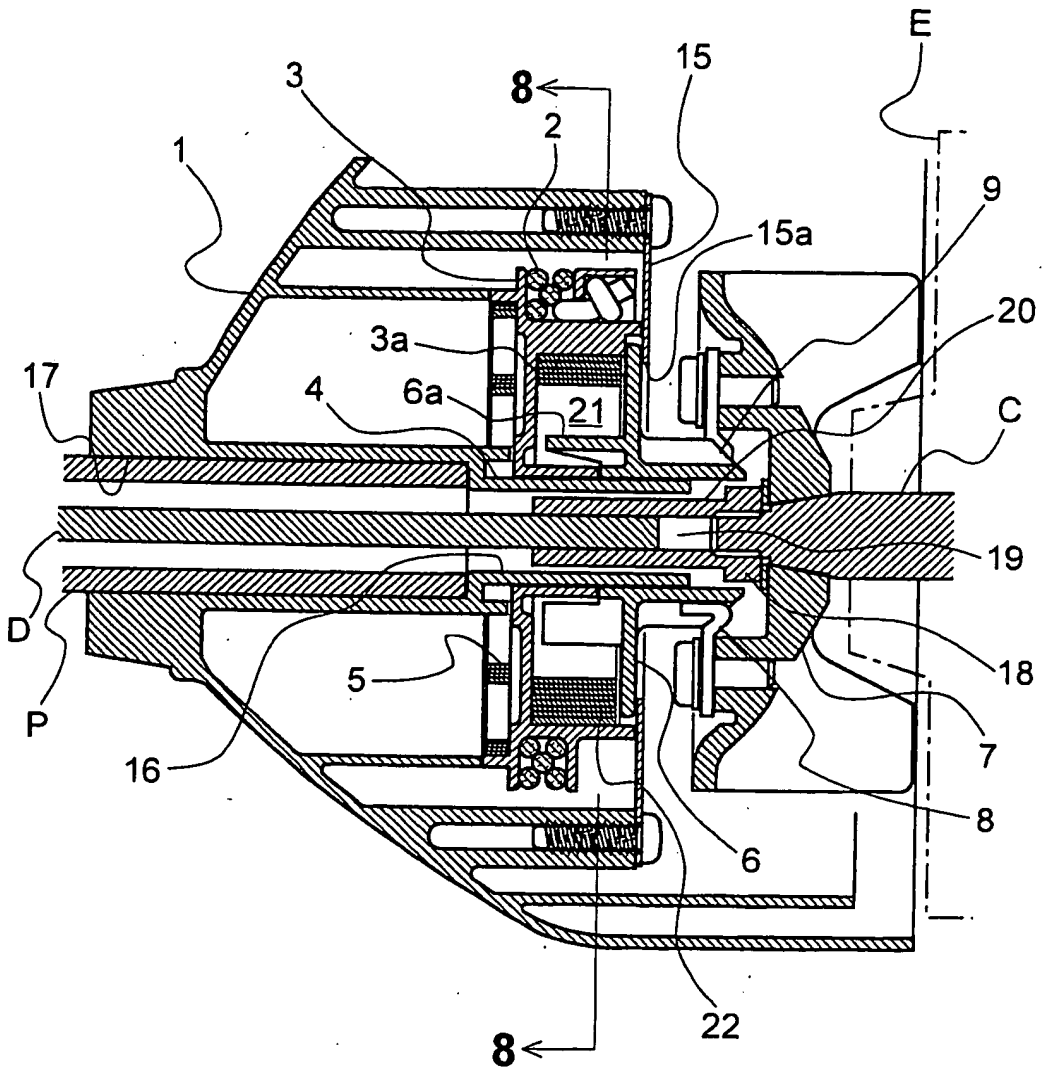
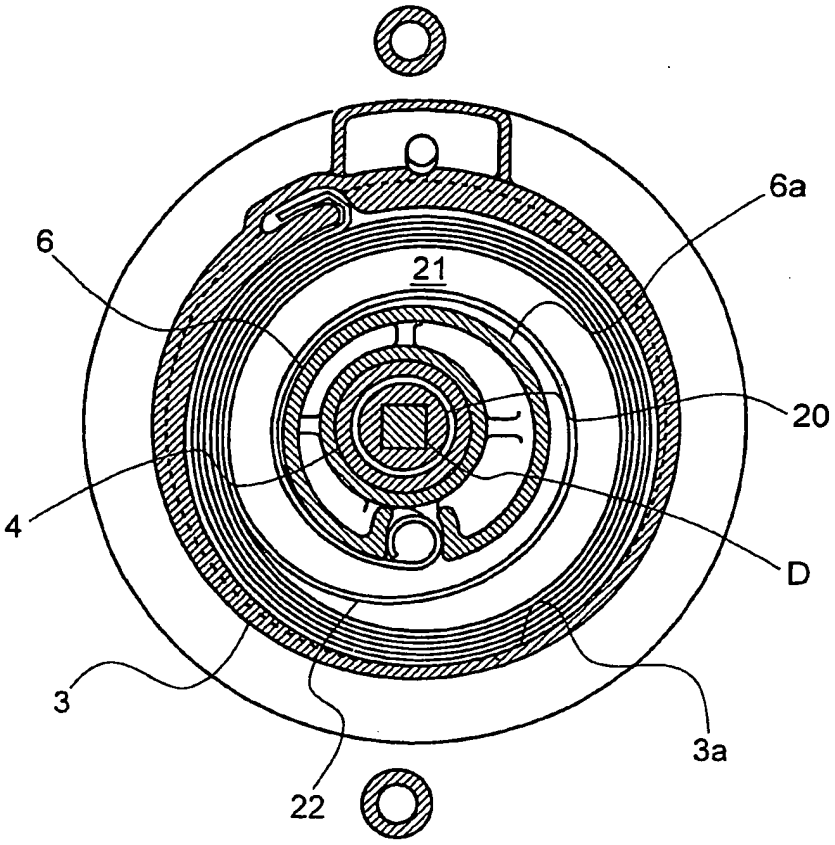


FIG. 8



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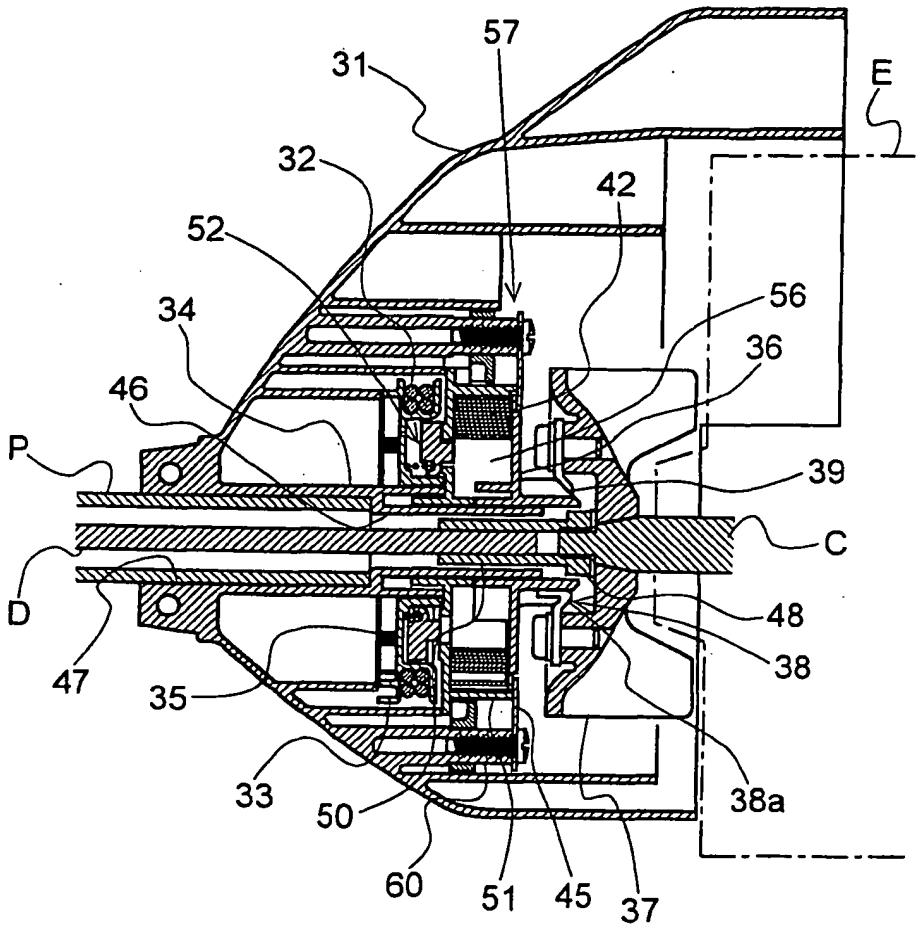

FIG. 10

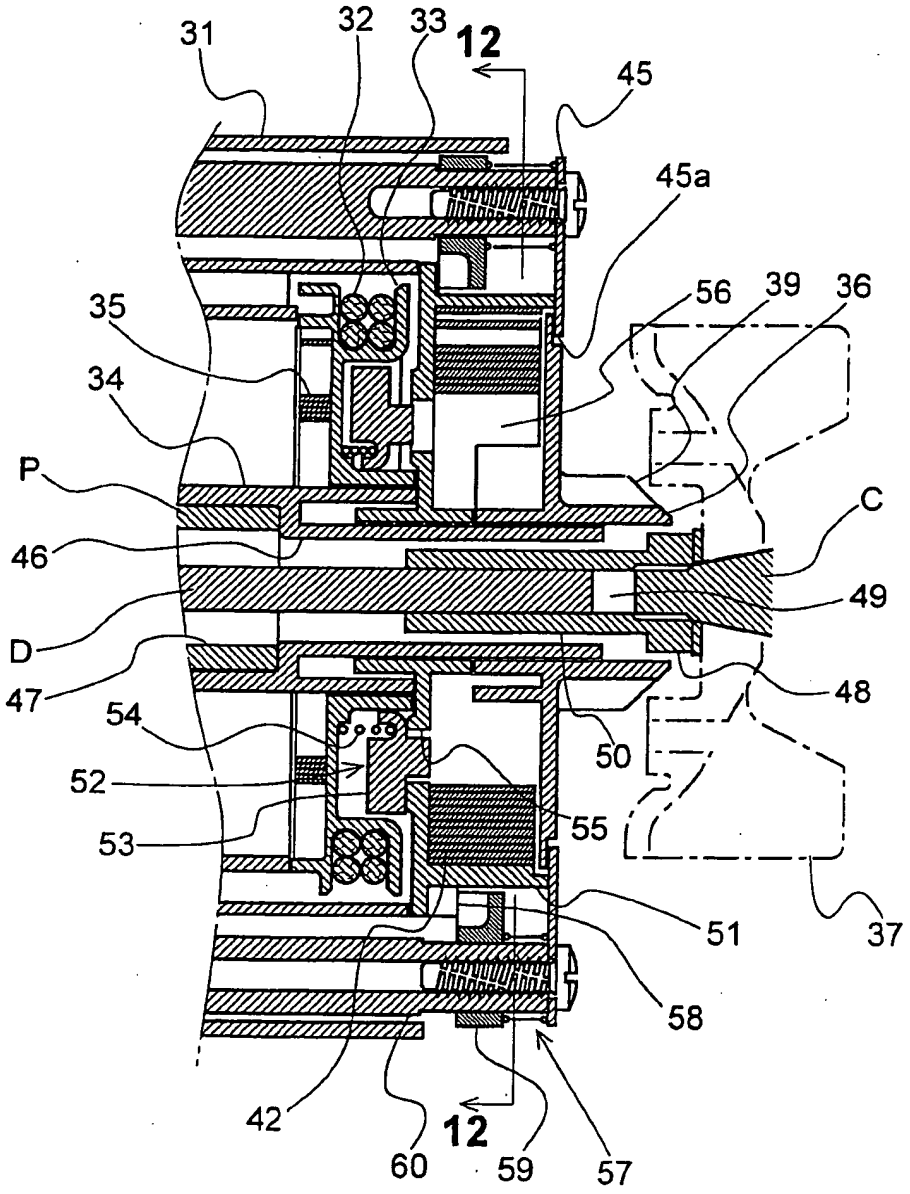
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FIG. 11

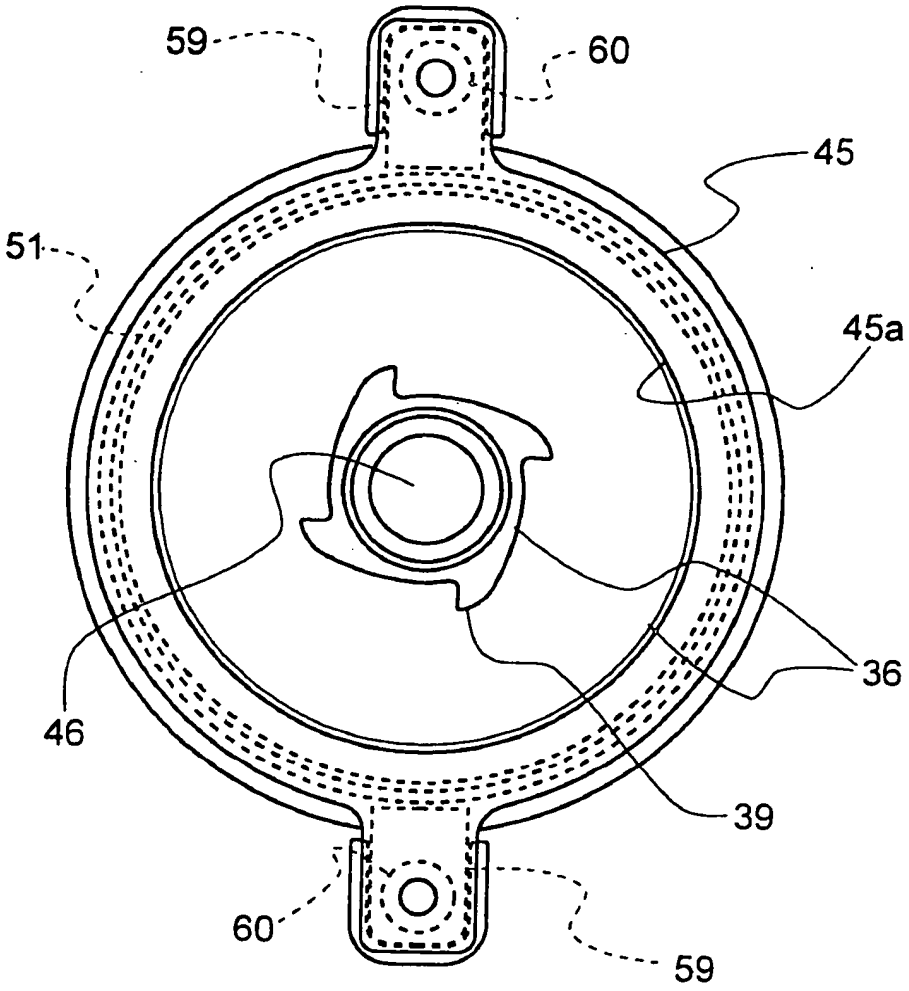
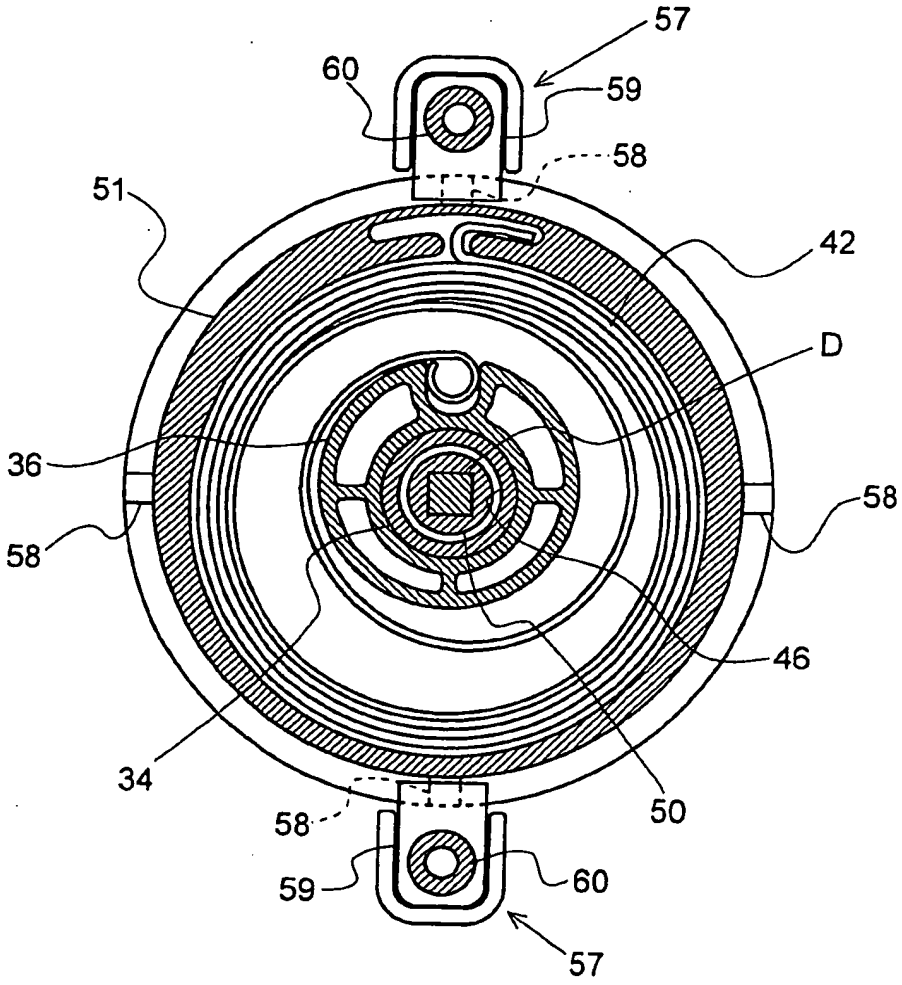


FIG. 12



RECOIL STARTER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a recoil starter having a recoil rope wound around a rope reel rotatably supported on a reel support shaft inside a starter housing, wherein the recoil rope is pulled to rotate the rope reel so that a rotational force of the rope reel is transmitted via a resilient member to a drive pulley or a flywheel magnet coupled to an engine to rotate the drive pulley or the flywheel magnet, whereby the engine is started.

[0003] 2. Description of the Related Art

[0004] A recoil starter is already known in which a rotational force of a rope reel rotated by pulling a recoil rope is transmitted to a cam rotatably supported coaxially with the rope reel, whereby a drive pulley coupled to a crankshaft of an engine is rotated via a one-way rotative mechanism such as a centrifugal clutch that engages with and disengages from the cam. In this recoil starter, the rope reel and the cam are resiliently coupled by a resilient member interposed between the rope reel and the cam, so that rotation of the rope reel resulting from pulling the recoil rope is transmitted to the cam via the resilient member, whereby a shock resulting from fluctuations in a load of the engine and transmitted to an operator's hand pulling the recoil rope at the time the engine is started is absorbed, and the crankshaft of the engine is rotated via the cam, the one-way rotative mechanism and the drive pulley by releasing the resilient force accumulated in the resilient member by the resilient member resiliently being deformed (e.g., see Japanese Utility Model Application Laid-Open Publication No. 2-149872).

[0005] A recoil starter is also known that is provided with a drive wheel which is rotated via a one-way clutch by a rope reel, and a spiral spring serving as an accumulation means interposed between the drive wheel and a cam which transmits rotation to a crankshaft of an engine, wherein the rope reel is rotated by pulling a recoil rope, the drive wheel is rotated via the one-way clutch, a rotational force is accumulated in the accumulation means by rotating the drive wheel when a starting load of an engine is large, and the cam is rotatingly driven by the rotational force accumulated in the accumulation means, whereby the engine is started (e.g., see Japanese Patent Application Laid-Open Publication No. 2001-132591).

[0006] In the above-described conventional recoil starters, the starter housing is so constructed that one end side thereof is open so as to cover one side surface of the engine at which an end portion of the crankshaft is disposed and the starter housing is provided with a reel support shaft that is integrally formed on a bottom portion thereof and projects therefrom to face the crankshaft of the engine. Structural parts such as the rope reel, the drive wheel and the cam are rotatably held on the reel support shaft in such a manner that detachment of these parts in an axial direction is prevented by a screw screwed into an end of the reel support shaft. The starter housing is mounted to a casing of the engine so that an open portion thereof faces the flywheel magnet or the drive pulley attached to the crankshaft of the engine.

[0007] In the above-described conventional recoil starters, the screw is fixed at the end of the reel support shaft formed on the starter housing in order to prevent the rope reel, the cam and the drive pulley from being detached from the reel support shaft. The starter housing is mounted to the side surface of the engine at which the crankshaft is disposed so as to receive therein the drive pulley or the flywheel magnet attached to the crankshaft of the engine. Accordingly, it is impossible to couple a device driven by the engine to the crankshaft on the side of the engine to which the recoil starter is attached. Also, in a small engine having a cantilever-type crankshaft, the crankshaft of the engine is only disposed at one side of the engine. Thus, there has been the problem that, when a drive shaft of a mower or the like is coupled to the crankshaft, it becomes impossible for the recoil starter to be attached.

SUMMARY OF THE INVENTION

[0008] The present invention has been made in view of the foregoing disadvantages of the prior art.

[0009] Accordingly, it is an object of the present invention to provide a recoil starter enabling a power-driven device driven by an engine to be coupled to a crankshaft of the engine in a state where the recoil starter is mounted to the crankshaft on the same side of the engine as the crankshaft is disposed on even when the engine has a cantilever-type crankshaft.

[0010] In accordance with the present invention, a recoil starter is provided. The recoil starter comprises: a starter housing adapted to be attachable to a side of an engine at which an end portion of a crankshaft of the engine is disposed; a rope reel rotatably supported inside the starter housing and around which is wound a recoil rope having an end pulled out to the outside of the starter housing; a cam rotatably supported coaxially with the rope reel and adapted to be rotated by rotation of the rope reel so as to cause the crankshaft of the engine to rotate via a one-way rotative mechanism; and a resilient means interposed between the rope reel and the cam, for resiliently and rotatingly coupling the rope reel and the cam, a rotational force of the rope reel rotated by pulling the recoil rope being transmitted to the cam via the resilient means, wherein a reel support shaft for rotatably supporting the rope reel and the cam inside the starter housing is formed on and projects from an inner surface of the starter housing toward the crankshaft of the engine; an opening is formed through a center of the reel support shaft in a manner to extend from a distal end thereof near the crankshaft of the engine to the outside of the starter housing; and a drive shaft of a power-driven device which is driven by the engine and disposed at the outside of the starter housing is coupled to the crankshaft of the engine inside the opening.

[0011] In a preferred embodiment of the present invention, the resilient means comprises a damper having one end thereof coupled to the rope reel and the other end thereof coupled to the cam so that the damper is adapted to buffer a shock resulting from fluctuations in a starting load of the engine and transmitted to the cam.

[0012] In a preferred embodiment of the present invention, the damper comprises a torsion coil spring having one end thereof engaged with the rope reel and the other end thereof engaged with the cam.

[0013] In a preferred embodiment of the present invention, the damper comprises a spiral spring having one end thereof engaged with the rope reel and the other end thereof engaged with the cam.

[0014] In a preferred embodiment of the present invention, the one-way rotative mechanism comprises a cam pawl formed on an outer peripheral surface of the cam, and a centrifugal ratchet that is provided on a rotating member attached to the crankshaft of the engine, the centrifugal ratchet adapted to engage with and disengage from the cam pawl due to a centrifugal force caused by rotation of the rotating member.

[0015] In a preferred embodiment of the present invention, an annular plate is secured to the starter housing so that the rope reel and the cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against the annular plate, whereby the rope reel and the cam are supported so that they are not detached in an axial direction from the reel support shaft.

[0016] In a preferred embodiment of the present invention, the recoil starter further includes a drive wheel disposed between the rope reel and the cam so that the drive wheel is permitted to rotate only in one direction through means of a one-way clutch provided between the rope reel and the drive wheel, wherein the resilient means is configured as an accumulation means for accumulating the rotational force of the rope reel side, and wherein the accumulation means is interposed between the drive wheel and the cam so as to accumulate a rotational force of the drive wheel rotated by the rope reel, whereby the cam is rotatingly driven by the rotational force accumulated in the accumulation means to cause the crankshaft of the engine to rotate.

[0017] In a preferred embodiment of the present invention, the accumulation means comprise a spiral spring having one end thereof engaged with the drive wheel and the other end thereof engaged with the cam. Alternatively, the accumulation means may comprise a torsion coil spring having one end thereof engaged with the drive wheel and the other end thereof engaged with the cam.

[0018] In a preferred embodiment of the present invention, the recoil starter further comprises a ratchet mechanism configured by an engagement tooth formed at an outer peripheral edge of the drive wheel and a ratchet supported on the starter housing so that the ratchet is engageable with the engagement tooth, wherein the ratchet mechanism permits the drive wheel to rotate only in an engine starting direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is an elevational sectional view showing a recoil starter according to an embodiment of the invention;

[0020] FIG. 2 is a cross-sectional view taken along line 2-2 of FIG. 1;

[0021] FIG. 3 is a rear view showing the recoil starter of FIG. 1 prior to attaching the recoil starter to an engine;

[0022] FIG. 4 is an enlarged elevational sectional view showing an essential part of the recoil starter of FIG. 1;

[0023] FIG. 5 is a cross-sectional view taken along line 5-5 of FIG. 4;

[0024] FIG. 6 is a cross-sectional view taken along line 6-6 of FIG. 4;

[0025] FIG. 7 is an elevational sectional view showing a recoil starter according to another embodiment of the invention;

[0026] FIG. 8 is a cross-sectional view taken along line 8-8 of FIG. 7;

[0027] FIG. 9 is an elevational sectional view showing a recoil starter according to yet another embodiment of the invention;

[0028] FIG. 10 is an enlarged elevational sectional view showing an essential part of the recoil starter of FIG. 9;

[0029] FIG. 11 is a rear view showing the recoil starter of FIG. 9 prior to attaching the recoil starter to an engine; and

[0030] FIG. 12 is a cross-sectional view taken along line, 12-12 of FIG. 10.

DETAILED DESCRIPTION OF THE INVENTION

[0031] The invention will be described hereinafter on the basis of embodiments. FIGS. 1 to 6 show a recoil starter according to a first embodiment of the invention. As shown in FIG. 1, the recoil starter includes a starter housing 1 formed to be attachable to one side of an engine E at which an end portion of a crankshaft C is disposed. A main mechanism configuring the recoil starter is mounted inside the starter housing 1. A reel support shaft 4 is integrally formed on an inner side of the starter housing 1 so as to project toward the crankshaft C of the engine E. A rope reel 3 having a recoil rope 2 wound thereon is rotatably supported on the reel support shaft 4. One end of the recoil rope 2 wound around the rope reel 3 is fixed to the rope reel 3, and the other end of the recoil rope 2 is pulled out to the outside of the starter housing 1. The recoil rope 2 is pulled out from the rope reel 3 by gripping and pulling an operating handle (not shown) joined to the other end of the recoil rope 2, whereby the rope reel 3 is rotatingly driven around the reel support shaft 4 in a rotational direction in which the engine is started.

[0032] A recoil spring 5 is disposed on a side surface of the rope reel 3 so as to rotate the rope reel 3 in an opposite direction, to thereby rewind the recoil rope 2, which has been pulled out from the rope reel 3 by pulling the recoil rope 2, around the rope reel 3. An end portion of an inner peripheral side of the recoil spring 5 is fixed to the starter housing 1, and the other end portion of the outer peripheral side of the recoil spring 5 is fixed to the rope reel 3. When the recoil rope 2 is pulled and the rope reel 3 is rotated in the rotational direction in which the engine E is started, a rotational force is accumulated in the recoil spring 5. By releasing the recoil rope 2, the rope reel 3 is rotated in the opposite direction by the rotational force accumulated in the recoil spring 5, whereby the recoil rope 2 is rewound around the rope reel 3.

[0033] A cam 6 is rotatably supported on a distal end portion of the reel support shaft 4 formed on the starter housing 1. The cam 6 transmits the rotational force of the rope reel 3 to the engine E via a drive pulley 7 joined to the crankshaft C of the engine E. A one-way rotative mechanism that transmits the rotation of the cam 6 in the engine starting

direction to the drive pulley 7 is provided between the cam 6 and the drive pulley 7. As shown in FIG. 2, the one-way rotative mechanism is configured by centrifugal ratchets 8, which are disposed on the drive pulley 7 and rotatingly activated by centrifugal force, and a plurality of cam pawls 9, which are formed on an outer peripheral surface of the cam 6 at intervals in a circumferential direction. Rotation of the cam 6 is transmitted to the drive pulley 7 by the cam pawls 9 engaging with the centrifugal ratchets 8 of the drive pulley 7, whereby the crankshaft C of the engine E is rotated. After the engine E has been started, the drive pulley 7 is rotated by the engine E, whereby the centrifugal ratchets 8 are rotated by a centrifugal force in a direction in which they disengage from the cam pawls 9 and rotational transmission between the engine E and the cam 6 is blocked.

[0034] As shown in FIG. 4, annular recesses 10 and 11 are respectively formed in mutually opposing side surfaces of the rope reel 3 and the cam 6 so that the annular recesses 10 and 11 face each other. A damper spring 12 configuring a resilient means is received in the annular recesses 10 and 11. The damper spring 12 is formed in the shape of a torsion coil spring. As shown in FIG. 4, one end of the damper spring 12 is received in a holding groove 13 formed in the rope reel 3, and the other end of the damper spring 12 is inserted into a holding hole 14 formed in the cam 6. Thus, the rope reel 3 and the cam 6 are resiliently and rotatingly coupled to each other through the damper spring 12. Thus, when the rope reel 3 is rotated in the engine starting direction by pulling the recoil rope 2 and when the rope reel 3 is rotated in the direction opposite to the engine starting direction by the recoil spring 5, the cam 6 is rotated via the damper spring 12 in the engine starting direction and the opposite direction, respectively.

[0035] As shown in FIGS. 3 and 4, an annular plate 15 is secured to the starter housing 1 by screws in order to regulate the movement of the rope reel 3 and the cam 6 supported on the reel support shaft 4 in an axial direction with respect to the reel support shaft 4. The annular plate 15 engages with outer peripheral portions of respective side surfaces of the rope reel 3 and the cam 6 to regulate the movement of the rope reel 3 and the cam 6 in the axial direction of the reel support shaft 4, whereby the cam 6 and the rope reel 3 are prevented from being detached from the reel support shaft 4. The cam pawls 9 formed on the cam 6 project from an opening 15*a*, which is formed in a center of the annular plate 15, toward the drive pulley 7 attached to the crankshaft C of the engine E.

[0036] When the rope reel 3 is rotated by pulling the recoil rope 2, the drive pulley 7 is rotated by the rotation of the rope reel 3 via the damper spring 12, the cam 6 and the centrifugal ratchets 8, whereby the crankshaft C of the engine E coupled to the drive pulley 7 is rotated. Although a rotational load is increased by starting resistance of the engine E and a rotational load of the cam 6 largely fluctuates to generate a shock at this time, the engine E can be smoothly started without the shock being directly transmitted to the recoil rope side because the damper spring 12 is twisted to absorb fluctuations of this rotational load.

[0037] The reel support shaft 4 on the inner side of the starter housing 1 is formed to be hollow. An opening 16 is formed trough a center portion of the reel support shaft 4 coaxially with the crankshaft C of the engine E in such a manner that the opening 16 extends from a distal end of the reel support shaft 4 near the crankshaft C to the outside of the starter housing 1. A drive shaft D of a power-driven device, such as a mower or the like, to be coupled to the crankshaft C and driven by the engine E is inserted from the outside of the starter housing 1 and passed through the opening 16 of the reel support shaft 4 so that the drive shaft D can be coupled to the crankshaft C of the engine E. An opening 17 which has a large inner diameter is formed in an outer end portion of the opening 16 of the starter housing 1 so that a pipe P which supports an activation mechanism of the device, such as a cutter portion of the mower, is inserted in the opening 17. As shown in FIG. 4, the pipe P is fitted in the opening 17 so that the device is integrally coupled with the engine E via the starter housing 1 enclosing the recoil starter.

[0038] A coupling shaft 20, which has a through-hole 19 of a polygonal section formed in a center portion thereof and which is integrally provided with a nut portion 18 for attaching and fixing the drive pulley 7 to the crankshaft C of the engine E, is arranged. The coupling shaft 20 is disposed inside the opening 16 formed in the center portion of the reel support shaft 4 of the starter housing 1 in a state where the nut portion 18 is screwed onto the crankshaft C of the engine E in order to attach the drive pulley 7 to the crankshaft C. The drive shaft D, which rotatingly drives a rotary cutter or the like of the mower serving as an example of the power-driven device, is disposed in a center portion of the pipe P. By inserting an end portion of the drive shaft D into the polygonal through-hole 19 of the coupling shaft 20, the crankshaft C of the engine E is rotatingly coupled to the drive shaft D via the coupling shaft 20, whereby the rotation of the crankshaft C is transmitted to the rotary cutter of the mower. That is, the device can be disposed on the side of the engine E where the end portion of the crankshaft C is arranged while the drive shaft D of the device passes through the center portion of the recoil starter and is coupled to the crankshaft C of the engine E.

[0039] Next, a recoil starter according to another embodiment of the invention shown in FIGS. 7 and 8 will be described. As shown in FIG. 7, in the recoil starter according to this embodiment, similar to the embodiment described above, the rope reel 3 having the recoil rope 2 wound thereon and the cam 6 that transmits rotation to the drive pulley 7 attached to the crankshaft C of the engine E are rotatably supported on the reel support shaft 4 formed on the inner surface of the starter housing 1 attached to one side of the engine E. The recoil spring 5 for rotating the rope reel 3 in the opposite direction to rewind the recoil rope 2 pulled out from the rope reel 3 is disposed on the side surface of the rope reel 3. The cam pawls 9 are formed on the cam 6 at intervals in the circumferential direction thereof. Rotation of the cam 6 is transmitted to the engine E via the centrifugal ratchets 8 provided on the drive pulley 7.

[0040] Moreover, in the recoil starter of the present embodiment, as shown in FIG. 8, the cam 6 is provided thereon with a boss portion 6*a* which is disposed inside a recess formed in the side surface of the rope reel 3. An annular recess 21 is formed between an inner peripheral surface 3*a* of the recess of the rope reel 3 and an outer peripheral surface of the boss portion 6*a* of the cam 6. A spiral spring 22 serving as a resilient means is received inside the annular recess 21. An end portion of an outer

peripheral side of the spiral spring 22 is held on the rope reel 3, and an end portion of the inner peripheral side of the spiral spring 22 is held on the boss portion 6*a* of the cam 6, whereby the rope reel 3 and the cam 6 are resiliently and rotatingly coupled via the spiral spring 22. The cam 6 is rotated, concurrent with the rotation of the rope reel 3, in the engine starting direction and in the opposite direction via the spiral spring 22. Also, the spiral spring 22 is adapted to be twisted when the rope reel 3 is relatively rotated with respect to the cam 6, whereby a shock resulting from fluctuations in the load of the cam 6 is buffered and the rotational force of the rope reel 3 is accumulated in the spiral spring 22.

[0041] When the recoil rope 2 is pulled so as to rotate the rope reel 3, the rotational force of the rope reel 3 is transmitted to the cam 6 via the spiral spring 22, so that the rotation of the cam 6 causes the drive pulley 7 to rotate via the centrifugal ratchets 8, resulting in the crankshaft C of the engine E coupled to the drive pulley 7 being rotated. Although the rotational load of the cam 6 is increased by the starting resistance of the engine E and a shock resulting from the fluctuations in the rotational load of the cam 6 is generated at the rope reel 3 at this time, the spiral spring 22 interposed between the cam 6 and the rope reel 3 is twisted to absorb the fluctuations in the load, and the rotational force is accumulated in the spiral spring 22. The rotational force accumulated in the spiral spring 22 is released at the time the engine E is started, so that the engine E can be started more smoothly.

[0042] Similar to the preceding embodiment, the opening 16 is formed in the center of the reel support shaft 4 coaxially with the crankshaft C of the engine E. The opening 16 extends from the distal end of the reel support shaft 4 near the crankshaft C to the outside of the starter housing 1. The drive shaft D of the power-driven device that is driven by the engine E and disposed on the outside of the starter housing 1 can be coupled to the crankshaft C inside the starter housing 1. The coupling shaft 20, which has the through-hole 19 of a polygonal section formed in the center portion thereof and which is integrally provided with the nut portion 18 for attaching and fixing the drive pulley 7 to the crankshaft C of the engine E, is arranged. The coupling shaft 20 is disposed inside the opening 16 in the center portion of the reel support shaft 4 formed on the starter housing 1. By inserting the drive shaft D of the device from the outside of the starter housing 1 and inserting the end portion of the drive shaft D into the polygonal through-hole 19 of the coupling shaft 20, the crankshaft C of the engine E is rotatingly coupled to the drive shaft D via the coupling shaft 20, so that the rotation of the crankshaft C is transmitted to the rotary cutter of the mower. That is, the device can be disposed on the side of the engine E where the end portion of the crankshaft C is arranged while the drive shaft D of the device is passed through the center portion of the recoil starter and coupled to the crankshaft C of the engine E.

[0043] Next, a recoil starter according to yet another embodiment of the invention shown in FIGS. 9 to 12 will be described. As shown in FIG. 9, a main mechanism of the recoil starter is mounted inside a starter housing 31 that is formed to be attachable to one side of an engine E at which an end portion of a crankshaft C is disposed. A reel support shaft 34 is integrally formed on the starter housing 31 so as to project from an inner wall surface of the starter housing 31 toward the crankshaft C of the engine E. A rope reel 33 having a recoil rope 32 wound thereon, one end of which is pulled out to the outside of the starter housing 31, is rotatably supported on the reel support shaft 34. One end of the recoil rope 32 wound around the rope reel 33 is fixed at the rope reel 33, and the other end of the recoil rope 32 is pulled out to the outside of the starter housing 31. The recoil rope 32 is pulled out from the rope reel 33 by pulling an operating handle (not shown) joined to an end portion of the recoil rope 32, whereby the rope reel 33 is rotatingly driven around the reel support shaft 34 in an engine starting direction.

[0044] A recoil spring 35 is disposed on a side surface of the rope reel 33 so as to rotate the rope reel 33 in a direction opposite to the engine starting direction, to thereby rewind the recoil rope 32, which has been pulled out by pulling the recoil rope 32, around the rope reel 33. One end of an inner peripheral side of the recoil spring 35 is fixed to the starter housing 31, and the other end of an outer peripheral side of the recoil spring 35 is fixed to the rope reel 33. When the recoil rope 32 is pulled and the rope reel 33 is rotated in the direction in which the engine E is started, a rotational force is accumulated in the recoil spring 35. By releasing the recoil rope 32 or lessening the pulling force, the rope reel 33 is rotated in the opposite direction by the rotational force accumulated in the recoil spring 35, whereby the recoil rope 32 is rewound around the rope reel 33.

[0045] A drive wheel 51 is rotatably supported, so as to be adjacent to the rope reel 33, on the reel support shaft 34 formed on the starter housing 31. A one-way clutch 52 that transmits the rotation of the rope reel 33 in the engine starting direction to the drive wheel 51 is provided between the rope reel 33 and the drive wheel 51. The one-way clutch 52 is configured by a clutch member 53, a clutch spring 54 and recesses 55. The clutch member 53 is received inside a recess formed in a side surface of the rope reel 33 facing the drive wheel 51, and is urged toward the drive wheel 51 by the clutch spring 54. The recesses 55, which are engageable with the clutch member 53, are formed in a side surface of the drive wheel 51 facing the clutch member 53. Due to the provision of the one-way clutch 52, when the recoil rope 32 is pulled, rotation of the rope reel 33 in the engine starting direction is transmitted to the drive wheel 51, whereas when the rope reel 33 is rotated in the opposite direction to rewind the recoil rope 32 around the rope reel 33, transmission of the rotation of the rope reel 33 is blocked, whereby the rotational force in the opposite direction is not transmitted to the drive wheel 51.

[0046] Moreover, a cam 36 that transmits rotation to the crankshaft C of the engine E is rotatably supported on the reel support-shaft 34. As shown in FIG. 9, a centrifugal clutch mechanism 38, which configures a one-way rotative mechanism that transmits the rotation of the cam 36 in the engine starting direction to a flywheel magnet 37 that is integrally joined to the crankshaft C of the engine E, is provided between the cam 36 and the flywheel magnet 37. The centrifugal clutch mechanism 38 is configured by centrifugal ratchets 38*a*, which are disposed on the flywheel magnet 37 and rotatingly activated by centrifugal force, and cam pawls 39, which are formed on an outer peripheral surface of the cam 36 and with which the centrifugal ratchets 38*a* disengageably engage. Rotation of the cam 36 in the engine starting direction is transmitted to the crankshaft C of the engine E by engagement of the cam pawls 39 with the

centrifugal ratchets 38*a* of the flywheel magnet 37. After the engine E has been started, the flywheel magnet 37 is rotated by the engine E, whereby the centrifugal ratchets 38*a* are rotated by centrifugal force in a direction in which they disengage from the cam pawls 39 and transmission of rotation between the engine E and the cam 36 is blocked.

[0047] A recess 56 is formed in a side surface of the drive wheel 51 facing the cam 36 so as to be open in one direction. A spiral spring 42 configuring an accumulation means is received inside the recess 56. As shown in FIG. 12, an outer peripheral side end of the spiral spring 42 is held on the drive wheel 51, and an inner peripheral side end of the spiral spring 42 is held on the cam 36. The drive wheel 51 and the cam 36 are thus rotatingly coupled via the spiral spring 42. When the drive wheel 51 is rotated by the rope reel 33, the cam 36 is rotated via the spiral spring 42. However, when the starting load of the engine E becomes large and the rotational resistance of the cam 36 increases to stop the rotation of the cam 36, the spiral spring 42 is wound by the drive wheel 51 that is rotated by the rope reel 33, whereby the rotational force is accumulated in the spiral spring 42.

[0048] A ratchet mechanism 57 that allows the drive wheel 51 to rotate only in the engine starting direction is disposed between the drive wheel 51 and the starter housing 31. The ratchet mechanism 57 is configured by engagement teeth 58 formed on an outer peripheral edge of the drive wheel 51 and ratchets 59 that engage with and disengage from the engagement teeth 58. The ratchets 59 are each supported on a support shaft 60 formed on the starter housing 31 so as to slide in an axial direction of the support shaft 60. The ratchets 59 are each urged by a spring in a direction in which the ratchets 59 engage with the engagement teeth 58. When the drive wheel 51 is rotated in the engine starting direction due to the rotation of the rope reel 33, the ratchets 59 are moved in the direction in which they disengage from the engagement teeth 58 counter to urging force of the springs, so that the engagement of the ratchets 59 with the engagement teeth 58 is released, resulting in rotation of the drive wheel 51 being allowed. However, when the drive wheel 51 is to be rotated by the spiral spring 42 in the direction opposite to the engine starting direction in a state where rotational force is accumulated in the spiral spring 42, the ratchets 59 engage with the engagement teeth 58 so that the rotation of the drive wheel 51 in the opposite direction is obstructed.

[0049] As shown in FIGS. 10 and 11, an annular plate 45 is attached to the starter housing 31 by screws. An opening 45*a* is formed in a center portion of the annular plate 45. The outer peripheral portions of the side surfaces of the drive wheel 51 and the cam 36 rotatably supported on the reel support shaft 34 engage with an annular portion of the annular plate 45, so that movement of the drive wheel 51 and the cam 36 in the axial direction of the reel support shaft 34 is regulated, whereby the drive wheel 51 and the cam 36 are prevented from being detached from the reel support shaft 34. The cam pawls 39 formed on the cam 36 project from the opening 45*a* formed in the center of the annular plate 45 toward the flywheel magnet 37 attached to the crankshaft C of the engine E.

[0050] When the drive wheel 51 is rotated by the rope reel 33 rotated by pulling the recoil rope 32, rotation is transmitted to the engine E via the spiral spring 42, the cam 36 and the centrifugal clutch mechanism 38. However, when the rotation of the cam 36 is obstructed by the starting resistance of the engine E, the drive wheel 51 rotated by the rope reel 33 winds up the spiral spring 42 and rotational force is accumulated in the spiral spring 42. When the pulling force of the recoil rope 32 is lessened, the rope reel 33 rotates in the opposite direction due to the action of the recoil spring 35 to rewind the recoil rope 32, whereas rotation of the drive wheel 51 in the opposite direction is obstructed by the ratchet mechanism 57, so that the rotational force accumulated in the spiral spring 42 is maintained without the drive wheel 51 rotating in the opposite direction. In this manner, when the recoil rope 32 is repeatedly pulled and the rotational force accumulated in the spiral spring 42 exceeds the starting resistance of the engine E acting on the cam 36, the cam 36 is abruptly rotated by the rotational force accumulated in the spiral spring 42, whereby the flywheel magnet 37 is rotated via the centrifugal ratchet mechanism 38, resulting in the engine E being started. Although the accumulation means in the present embodiment is configured by the spiral spring 42, instead, the accumulation means may comprise a torsion coil spring having one end thereof engaged with the drive wheel 51 and the other end thereof engaged with the cam 36.

[0051] An opening 46 is formed in a center portion of the reel support shaft 34 formed on the starter housing 31. The opening 46 penetrates the reel support shaft 34 to the outside of the starter housing 31 on the extension of the crankshaft C of the engine E. A drive shaft D of a power-driven device to be coupled with the crankshaft C of the engine E is inserted from the outside of the starter housing 31 and passed through the opening 46 of the reel support shaft 34, whereby the drive shaft D can be coupled to the crankshaft C inside the starter housing 31. An opening 47 which has a large inner diameter is formed in an outer end portion of the opening 46 of the starter housing 31. The opening 47 has fitted therein a pipe P supporting an activation mechanism of the device, such as a cutter portion of a mower, so that the device is coupled to the engine E via the starter housing 31 enclosing the recoil starter.

[0052] A coupling shaft 50, which has a through-hole 49 of a polygonal section formed in a center portion thereof and which is integrally formed with a nut portion 48 that attaches and fixes the flywheel magnet 37 to the crankshaft C of the engine E, is provided. The coupling shaft 50 is disposed inside the opening 46 formed in the center portion of the reel support shaft 34 of the starter housing 31 in a state where the nut portion 48 is screwed onto the crankshaft C in order to attach the flywheel magnet 37 to the crankshaft C of the engine E. The drive shaft D that drives a rotary cutter or the like of the mower is disposed in the center portion of the pipe P coupling the mower to the engine E. By inserting an end portion of the drive shaft D into the polygonal through-hole 49 of the coupling shaft 50, the crankshaft C of the engine E and the drive shaft D are coupled via the coupling shaft 50 while the drive shaft D passes through the recoil starter, whereby the rotation of the crankshaft C is transmitted to the rotary cutter of the mower. That is, the device can be disposed on the side of the engine E where the end portion of the crankshaft C is arranged while the drive shaft D of the device passes through the center portion of the recoil starter and is coupled to the crankshaft C of the engine E.

[0053] As described above, according to the invention, the opening that extends to the outside of the starter housing along the axial line of the crankshaft of the engine is formed in the center portion of the reel support shaft formed on the starter housing, and the drive shaft of the device is coupled to the crankshaft of the engine inside the opening. Such construction permits rotational output of the crankshaft of the engine to be taken out to the outside of the starter housing while passing through the center portion of the starter housing via the opening of the reel support shaft. Accordingly, it is possible to dispose the recoil starter between the engine and the device driven by the engine even when the engine has a cantilever-type crankshaft disposed only at one side thereof.

[0054] In one embodiment of the invention, the damper, such as a torsion coil spring or a spiral spring, is interposed between the rope reel and the cam, so that a shock resulting from fluctuations in the starting load of the engine can be buffered by the damper and is not transmitted to the rope reel. Moreover, since the rotational force of the rope reel is accumulated in the damper and the rotational force thus accumulated is released to start the engine, the engine can be started easily.

[0055] In one embodiment of the invention, since the drive wheel is interposed between the rope reel and the cam and the accumulation means is disposed between the drive wheel and the cam, the rotational force is accumulated in the accumulation means by repeatedly pulling the recoil rope, so that the crankshaft of the engine can be rotated by the rotational force accumulated in the accumulation means. Thus, it is possible for the engine to be started easily.

[0056] While illustrative and presently preferred embodiments of the present invention have been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

What is claimed is:

1. A recoil starter comprising:

a starter housing adapted to be attachable to a side of an engine at which an end portion of a crankshaft of the engine is disposed;

a rope reel rotatably supported inside said starter housing and around which is wound a recoil rope having an end pulled out to the outside of said starter housing;

a cam rotatably supported coaxially with said rope reel and adapted to be rotated by rotation of said rope reel so as to cause said crankshaft of the engine to rotate via a one-way rotative mechanism; and

a resilient means, interposed between said rope reel and said cam, for resiliently and rotatingly coupling said rope reel and said cam, a rotational force of said rope reel rotated by pulling said recoil rope being transmitted to said cam via said resilient means; wherein

a reel support shaft for rotatably supporting said rope reel and said cam inside said starter housing is formed on and projects from an inner surface of said starter housing toward the crankshaft of the engine;

an opening is formed through a center of said reel support shaft in a manner to extend from a distal end thereof near the crankshaft of the engine to the outside of said starter housing; and

a drive shaft of a power-driven device which is driven by the engine and disposed at the outside of said starter housing is coupled to the crankshaft of the engine inside said opening.

2. The recoil starter according to claim 1, wherein said resilient means comprises a damper having one end thereof coupled to said rope reel and the other end thereof coupled to said cam so that said damper is adapted to buffer a shock resulting from fluctuations in a starting load of the engine and transmitted to said cam.

3. The recoil starter according to claim 2, wherein said damper comprises a torsion coil spring having one end thereof engaged with said rope reel and the other end thereof engaged with said cam.

4. The recoil starter according to claim 2, wherein said damper is a spiral spring having one end thereof engaged with said rope reel and the other end thereof engaged with said cam.

5. The recoil starter according to claim 2, wherein said one-way rotative mechanism comprises a cam pawl formed on an outer peripheral surface of said cam and a centrifugal ratchet provided on a rotating member which is attached to the crankshaft of the engine, said centrifugal ratchet being adapted to engage with and disengage from said cam pawl due to a centrifugal force caused by rotation of said rotating member.

6. The recoil starter according to claim 3, wherein said one-way rotative mechanism comprises a cam pawl formed on an outer peripheral surface of said cam and a centrifugal ratchet provided on a rotating member which is attached to the crankshaft of the engine, said centrifugal ratchet being adapted to engage with and disengage from said cam pawl due to a centrifugal force caused by rotation of said rotating member.

7. The recoil starter according to claim 4, wherein said one-way rotative mechanism comprises a cam pawl formed on an outer peripheral surface of said cam and a centrifugal ratchet provided on a rotating member which is attached to the crankshaft of the engine, said centrifugal ratchet being adapted to engage with and disengage from said cam pawl due to a centrifugal force caused by rotation of said rotating member.

8. The recoil starter according to claim 2, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

9. The recoil starter according to claim 3, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

10. The recoil starter according to claim 4, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment

against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

11. The recoil starter according to claim 5, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

12. The recoil starter according to claim 6, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

13. The recoil starter according to claim 7, wherein an annular plate is secured to said starter housing so that said rope reel and said cam are brought at outer peripheral portions of respective side surfaces thereof into abutment against said annular plate, whereby said rope reel and said cam are supported so that they are not detached in an axial direction from said reel support shaft.

14. The recoil starter according to claim 1, further comprising a drive wheel disposed between said rope reel and said cam so that said drive wheel is permitted to rotate only in one direction through means of a one-way clutch provided between said rope reel and said drive wheel, wherein

said resilient means is configured as an accumulation means for accumulating the rotational force of the rope reel side, and wherein

said accumulation means is interposed between said drive wheel and said cam so as to accumulate a rotational force of said drive wheel rotated by said rope reel, whereby said cam is rotatingly driven by the rotational force accumulated in said accumulation means to cause the crankshaft of the engine to rotate.

15. The recoil starter according to claim 14, wherein said accumulation means comprises a spiral spring having one end thereof engaged with said drive wheel and the other end thereof engaged with said cam.

16. The recoil starter according to claim 14, further comprising a ratchet mechanism configured by an engagement tooth formed at an outer peripheral edge of said drive wheel and a ratchet supported on said starter housing so that said ratchet is engageable with said engagement tooth, wherein said ratchet mechanism permits said drive wheel to rotate only in an engine starting direction.

17. The recoil starter according to claim 15, further comprising a ratchet mechanism configured by an engagement tooth formed at an outer peripheral edge of said drive wheel and a ratchet supported on said starter housing so that said ratchet is engageable with said engagement tooth, wherein said ratchet mechanism permits said drive wheel to rotate only in an engine starting direction.

* * * * *

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Kokoku No. 52-31487 (JP, B2)

(54) Title of the Utility Model: Recoil Starter

[Claims]

[Claim 1] A recoil starter, wherein the recoil starter transmits the rotation of a reel to a pulley on the engine side using a centrifugal ratchet cam, wherein the cam is mounted rotatably on the outer periphery of a boss section extending from the bearing section of the reel, and wherein the reel and the cam are connected by a damper spring.

[Detailed Description of the Utility Model]

(Industrial Field of Application)

The present utility model relates to a recoil starter transmitting the rotation of a reel to a pulley on the engine side using a centrifugal ratchet cam.

(Prior Art)

In this type of recoil starter, a rope is pulled to rotate a reel, a cam is fixed to the reel, and a pulley connects a centrifugal ratchet engaging the cam to the engine side.

(Problem Solved by the Utility Model)

However, in a recoil starter with this configuration where the cam is integrated with the reel, the shock of engine compression at start up is transmitted to the hand, making

start up difficult, and the shock of ratchet and cam engagement during reverse rotation at shut down is also transmitted, often causing damage.

Therefore, the purpose of the present utility model is to provide a recoil starter that solves this problem.

(Means of Solving the Problem)

The present utility model is a recoil starter, wherein the recoil starter transmits the rotation of a reel to a pulley on the engine side using a centrifugal ratchet cam, wherein the cam is mounted rotatably on the outer periphery of a boss section extending from the bearing section of the reel, and wherein the reel and the cam are connected by a damper spring.

(Operation)

Because the reel and rotatably mounted cam are connected by a damper spring, the distortion of the damper spring by the sudden load at start up is absorbed (accumulating power), thereby reducing the load impact. Because the energy of the accumulating power is released as the compression progresses, the engine is accelerated and start up is easy. Because the engagement shock from reverse rotation during engine shut down is also absorbed, the starter is unaffected. As a result, the problem associated with the prior art is solved.

(Working Example)

FIG 1 is a cross-sectional view of the recoil starter in the working example of the present utility model. FIG 2 is a cross-sectional view from A-A in FIG 1. In these figures, 1 is the case for the recoil starter, the spindle 1a protrudes inwardly at the center, and the bearing 2a for the reel 2 is inserted rotatably. A spring 3 is accommodated along the inside surface of the starter case 1 with the outer end engaging the starter case 1 and the inner end engaging the bearing 2a. After the rope 4 coiled around the reel 2 has been pulled out with resistance from the spring 3 and the rope 4 is released by the hand, the rope 4 is again taken up by the reel 2.

A cylindrical recess is formed in the outer periphery of the bearing 2a for the reel 2, one end of the damper spring 5 is fixed in the direction of rotation, a boss section 2b extending the bearing is attached to the cam 6, and the cam 6 is mounted rotatably to the outer periphery. A groove 6a is formed on the cam 6 to fix the other end of the damper spring 5 in the direction of rotation. The centrifugal ratchet 9 engaging the cam 6 is mounted on the pulley 8 attached to the crankshaft 7, and pressure is applied by a return spring 10 to keep the ratchet 9 engaged with the cam 6 under most circumstances. Here, 11 is the crank case attached to the starter case 1, 12 is a check plate keeping the cam 6 from coming off, and 13 is a retaining ring.

The following is a description of the operation of a recoil starter with this configuration.

First, from the static position shown in FIG 2, the rope 4 is pulled out with resistance from the spring 3, the reel 2 is rotated, the cam 6 connected to the reel 2 via damper spring 5 is rotated, the pulley 8 and crankshaft 7 are rotated by the ratchet 9 engaging

the cam 6, and the engine is started up. After the engine has started up, the rope 4 is released from the hand, centrifugal force moves the ratchet 9 outward against the damper spring 10 to release the cam 6, the spring 3 reverses the rotation of the reel 2, and the rope 4 is taken up by the reel 2.

(Effect of the Utility Model)

As explained above in detail, because the reel and rotatably mounted cam are connected by a damper spring, the distortion of the damper spring by the sudden load at start up is absorbed (accumulating power), thereby reducing the load impact. Because the accumulating power energy is released as the compression progresses, the engine is accelerated and start up is easy. Because the engagement shock during reverse rotation of the engine at shut down is also absorbed, the starter is unaffected. The starter also has a simple configuration.

[Brief Explanation of the Drawings]

FIG 1 is a cross-sectional view of the recoil starter in the working example of the present utility model. FIG 2 is a cross-sectional view from A-A in FIG 1.

[Key to the Drawings]

1 ... starter case, 1a ... spindle, 2 ... reel, 2b ... boss section, 3 ... spring, 4 ... rope, 5 ... damper spring, 6 ... cam, 7 ... crankshaft, 8 ... pulley, 9 ... ratchet, 10 ... return spring

[FIG 1]

(Cross-Sectional View of Recoil Starter in Working Example of Present Utility Model)

1 ... starter case, 1a ... spindle, 2 ... reel, 2a ... bearing, 2b ... boss section, 3 ... spring, 4 ... rope, 5 ... damper spring, 6 ... cam, 7 ... crankshaft, 8 ... pulley, 9 ... ratchet, 10 ... return spring, 11 ... crank case, 12 ... check plate, 13 ... retaining ring

[FIG 2]

(Cross-Sectional View From A-A in FIG 1)

5 ... damper spring, 6 ... cam, 6a ... groove

Translator's Certification

November 18, 2003

I translated Japanese Examined Utility Model Application Publication No. 6-16964 (Y2) from Japanese into English. I am an experienced translator thoroughly conversant in both languages and the document I submitted is to the best of my knowledge an accurate translation of the original Japanese.

Frank McGee
Japanese-English Technical and Legal Translator

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(56)参考文献　特開　昭52－110345（ＪＰ，Ａ）
特公　昭52－31487（ＪＰ，Ｂ２）

(54)【考案の名称】　リコイルスタータ

1

【実用新案登録請求の範囲】

【請求項１】遠心ラチエットカムを利用してリールの回転をエンジン側のプーリに伝達するリコイルスタータにおいて、カムをリールの軸受部を延長したボス部の外周に回転可能に取付け、リールと前記カムの間をダンパースプリングで連結したことを特徴とするリコイルスタータ。

【考案の詳細な説明】

（産業上の利用分野）

この考案は遠心ラチエツトとカムを利用してリールの回転をエンジン側のプーリに伝達させるリコイルスタータに関するものである。

（従来の技術）

従来、この種リコイルスタータはロープを引くことによりリールを回転せしめ、このリールに固定して設けられ

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たカムと、このカムに噛み合う遠心ラチエツトをエンジン側に直結したプーリに関着させて駆動させる構成であつた。

（考案が解決しようとする問題点）

しかしながら、カムとリールが一体に設けられた上記構成のリコイルスタータでは、始動時におけるエンジンの圧縮時のシヨツクが手に直接伝わり、このため始動がやりにくかつたり、またエンジンの停止時の逆転によるラチエツトとカムの噛合シヨツクがスタータ全体に伝わり、破損の原因になるという問題点があつた。

したがつて、この考案は上記問題点を解決したリコイルスタータを提供しようとするものである。

（問題点を解決するための手段）

この考案は、遠心ラチエツトとカムを利用してリールの回転をエンジン側のプーリに伝達するようにしたリコイ

ルスタータにおいてカムをリールの軸受部を延長したボス部の外周に回転可能に取付け、リールとカムの間にダンパースプリングで連結せしめたものである。

（作用）

このように、リールと回転可能に取付けたカムの間をダンパースプリングで連結したので、始動時の急撃な負荷に対してはダンパースプリングの変形によつて吸収（蓄力）して衝撃的な負荷を柔らげ、同時に圧縮行程を起ると、蓄力されたエネルギーが放出されるため、エンジンを加速し始動し易くなる。またエンジンの停止時もエンジンの逆転による噛合のシヨツクを吸収するため、スタータに無理が掛らないようになる。したがつて前記問題点が解消される。

（実施例）

第１図は本考案リコイルスタータの一実施例を示す断面図、第２図は第１図のＡ－Ａ断面図である。図において、１はリコイルスタータのケースで、その中央部内側には支軸1aが突出して設けられ、リール２の軸受2aが回転自在に挿入されている。また、スタータケース１の内面に沿つてゼンマイ３が収容されその外端かスタータケース１に、一方の内端が前記軸受2aに係止され、リール２に巻回したロープ４をゼンマイ３に抗して引出した後、手をロープ４より放つとロープ４は再度リール２に収容れるようになつている。

このリール２の軸受2aの外周部に円形状の凹所を設け、ダンパースプリング５の一端を回転方向に固定し、また前記リール２に軸受部を延長したボス部2bを設けその外周にカム６を回転可能に組付ける。このカム６には前記ダンパースプリング５の他端が回転方向に固定する溝6aが設けられている。一方、クランクシヤフト７に組付けられたブーリ８には前記カム６と噛み合う遠心ラチエツト９が取付けられ、このラチエツト９はリターンスプリ＊

＊ング10により常時カム６と噛み合うよう付勢されている。なお11はスタータケース１を取付けるフランクケース、12はカム６の抜け止めのための抑え板、13は止輪を示す。

次に、このような構成のリコイルスタータの動作について述べる。

先ず、第２図に示す静止状態より、ロープ４をゼンマイ３に抗して引張るとリール２が回転し、さらにリール２とダンパースプリング５を介して連結されるカム６、そのカム６と噛み合うラチエツト９を介してブーリ８及びクランクシヤフト７が回転し、エンシンが始動される。

次に始動後、ロープ４を手から放すとラチエツト９が遠心力でリタンスプリング10に抗して外方に動き、カム６を解放すると同時にゼンマイ３によつてリール２は逆回転し、ロープ４もリール２に巻き戻される。

（考案の効果）

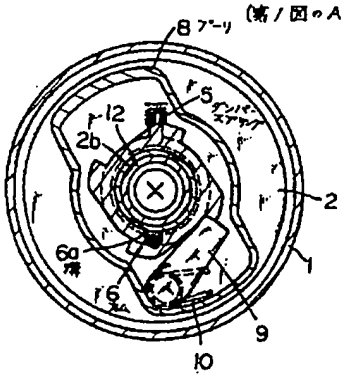
以上詳細に説明したように、本考案によれば始動時の急撃な負荷に対してもダンパースプリング５の変形で吸収（蓄力）し、衝撃的な負荷を柔らげると同時に、圧縮行程を起えると蓄力されたエネルギーが放出されるためエンジンを加速し始動し易くなる。また、エンジンの停止時もエンジンの逆転による噛合のシヨツクを吸収するため、スタータに無理が掛らない等簡単な構造で多くの効果がある。

【図面の簡単な説明】

第１図は本考案リコイルスタータの一実施例を示す断面図、第２図は第１図のＡ－Ａ断面図である。

1…スタータケース、1a…支軸、２…リール、2b…ボス部、３…ゼンマイ、４…ロープ、５…ダンパースプリング、６…カム、７…クランクシヤフト、８…ブーリ、９…ラチエツト、10…リタンスプリング

【第２図】



【第1図】

（本考案に係るリコイルスタータの断面図）